US009383922B2

(12) **United States Patent**
Bader

(10) **Patent No.: US 9,383,922 B2**
(45) **Date of Patent: Jul. 5, 2016**

(54) **KEYBOARD-BASED NAVIGATION OF A USER INTERFACE**

(75) Inventor: **Bjoern Bader**, Eppelheim (DE)

(73) Assignee: **SAP SE**, Walldorf (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 339 days.

(21) Appl. No.: **13/609,256**

(22) Filed: **Sep. 11, 2012**

(65) **Prior Publication Data**

US 2014/0075386 A1 Mar. 13, 2014

(51) **Int. Cl.**
G06F 3/0489 (2013.01)
G06F 3/0484 (2013.01)
G06F 3/0488 (2013.01)

(52) **U.S. Cl.**
CPC ***G06F 3/04892*** (2013.01); ***G06F 3/04842*** (2013.01); *G06F 3/04886* (2013.01)

(58) **Field of Classification Search**
CPC G06F 17/30905; G06F 17/2229; G06F 3/04886; G06F 3/04842
USPC 715/825
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,788,601 B2 * 8/2010 Scott 715/812
2001/0017634 A1 * 8/2001 Scott G06F 3/04892 715/767
2004/0210851 A1 * 10/2004 Premchandran G06F 3/04892 715/851
2011/0276910 A1 * 11/2011 Mouyade et al. 715/767
2012/0036434 A1 * 2/2012 Oberstein 715/702
2013/0167060 A1 * 6/2013 Wang 715/769

FOREIGN PATENT DOCUMENTS

WO WO02/052395 A2 * 12/2001

OTHER PUBLICATIONS

Samet et al. Storing a collection of polygons using quadtrees; pp. 1-41; © 1985.*
WO 02/052395 A2; Glasslander, Display Generating Device, Dec. 14, 2001.*
Samet et al. (Storing a collection of polygons using quadtrees; pp. 1-41; © 1985).*

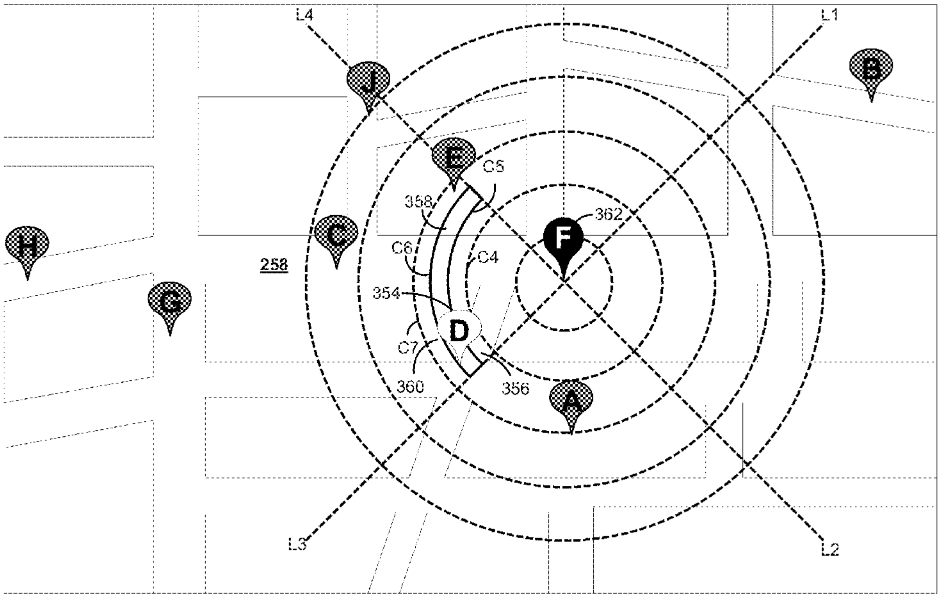
* cited by examiner

Primary Examiner — Sherrod Keaton

(57) **ABSTRACT**

Various embodiments of systems and methods for keyboard-based navigation of a user interface are described herein. An area around a first object displayed on a user interface is divided into quadrants and one or more segments for at least one of the quadrants. The user interface includes a plurality of objects and the quadrants represent directions with respect to the first object. In response to a key stroke indicating a first direction, a first one of the quadrants corresponding to the first direction is identified. The segments of the first quadrant are scanned to identify a second object that is closest to the first object in the first quadrant. The second object is then selected.

22 Claims, 27 Drawing Sheets



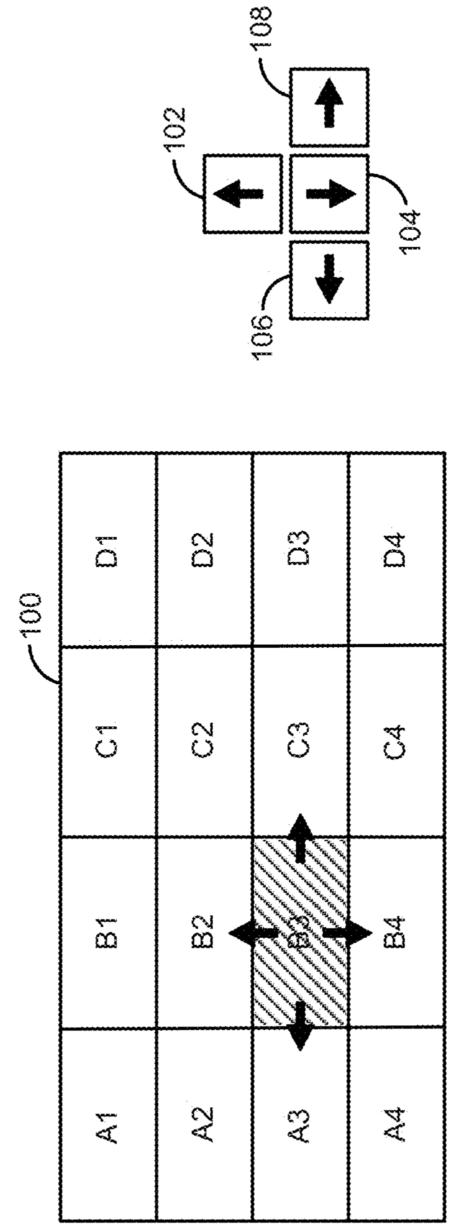
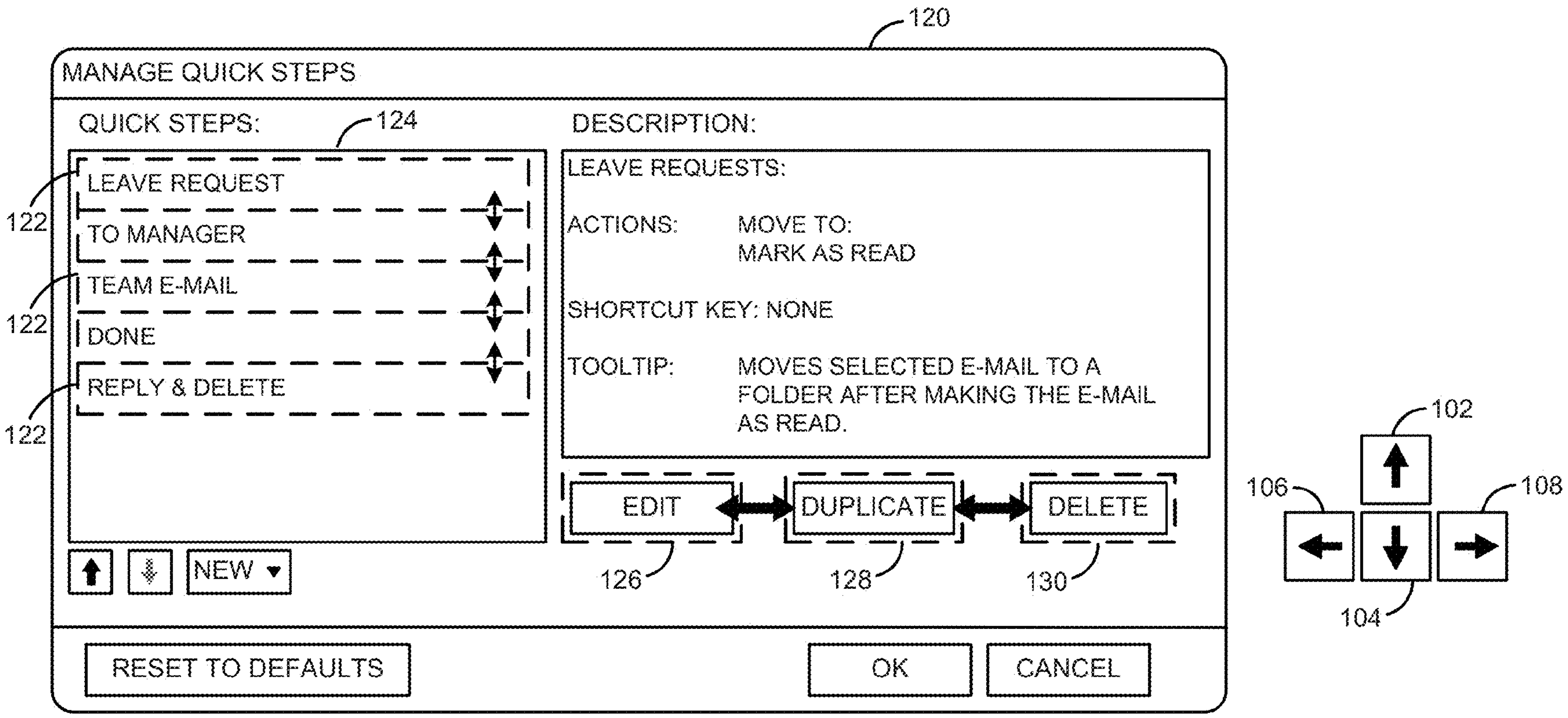


FIG. 1



LEAVE REQUESTS:

ACTIONS: MOVE TO:
MARK AS READ

SHORTCUT KEY: NONE

TOOLTIP: MOVES SELECTED E-MAIL TO A FOLDER AFTER MAKING THE E-MAIL AS READ.

FIG. 2

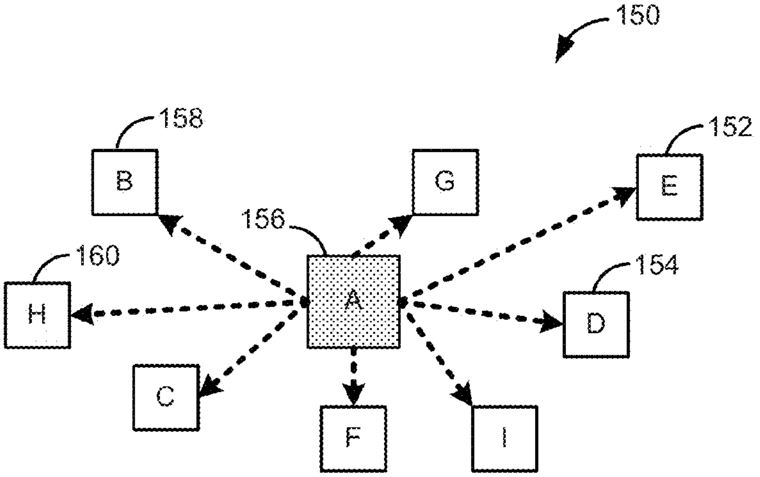

150
158
B
G
152
E
156
A
160
H
154
D
C
F
I

FIG. 3A

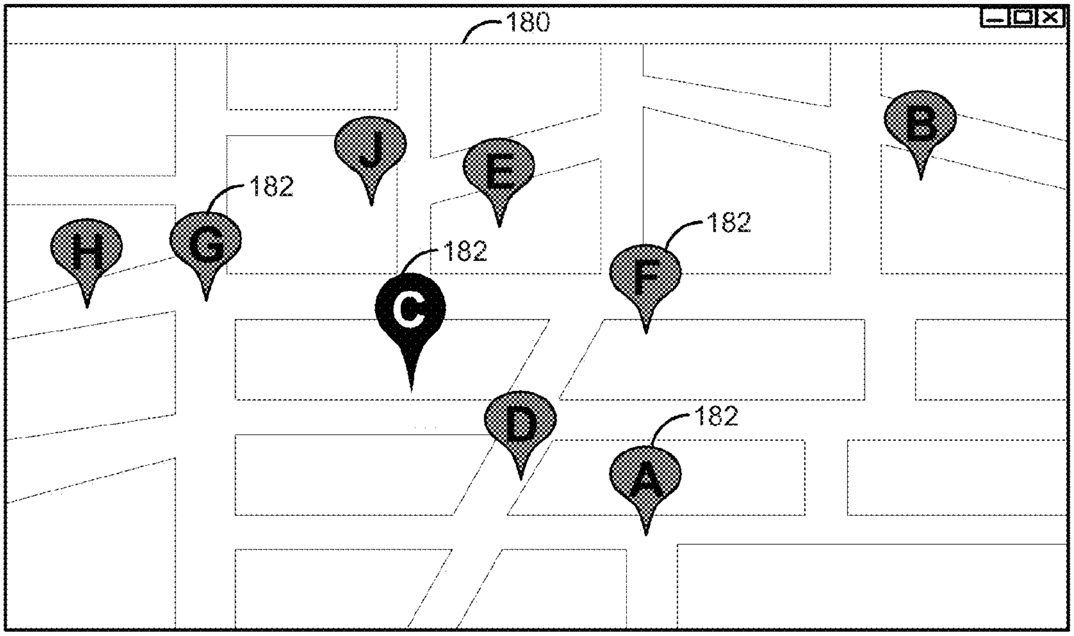

180
B
J
E
182
H
G
182
F
182
C
D
182
A

FIG. 3B

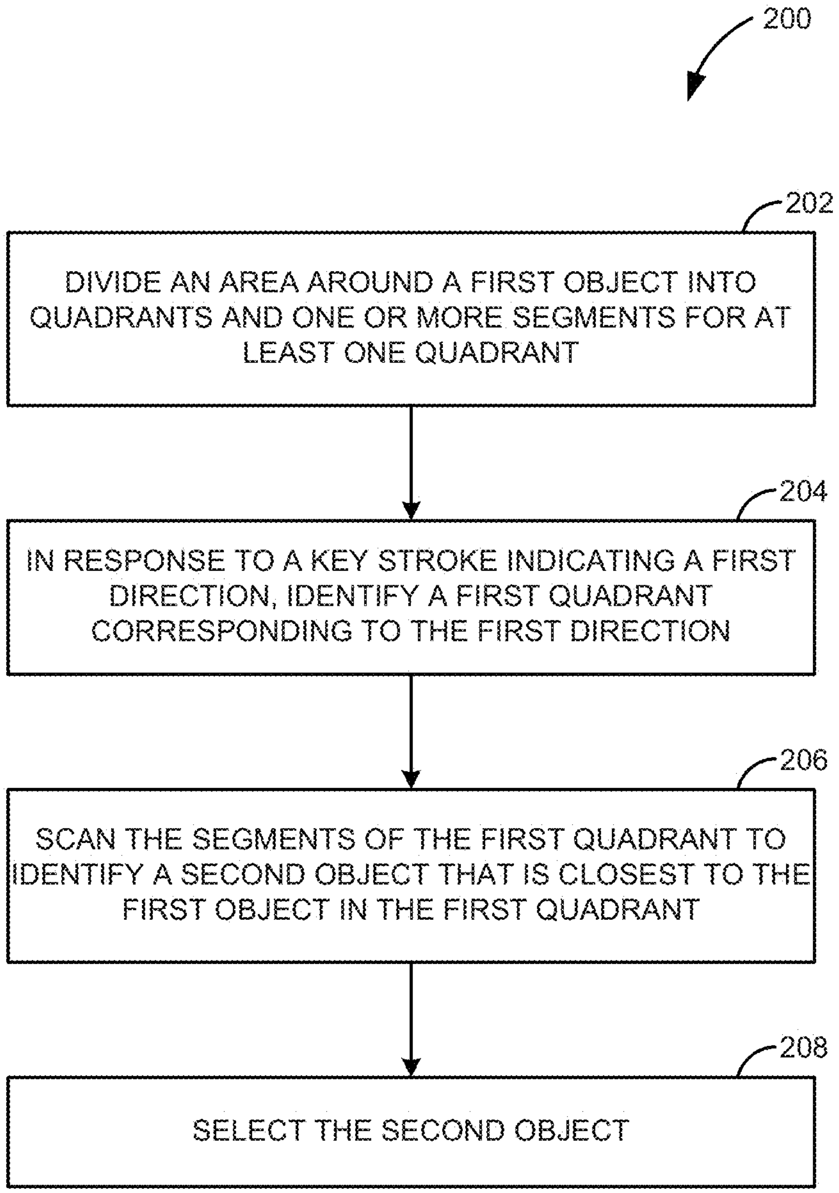

200
202
DIVIDE AN AREA AROUND A FIRST OBJECT INTO QUADRANTS AND ONE OR MORE SEGMENTS FOR AT LEAST ONE QUADRANT
204
IN RESPONSE TO A KEY STROKE INDICATING A FIRST DIRECTION, IDENTIFY A FIRST QUADRANT CORRESPONDING TO THE FIRST DIRECTION
206
SCAN THE SEGMENTS OF THE FIRST QUADRANT TO IDENTIFY A SECOND OBJECT THAT IS CLOSEST TO THE FIRST OBJECT IN THE FIRST QUADRANT
208
SELECT THE SECOND OBJECT

FIG. 4

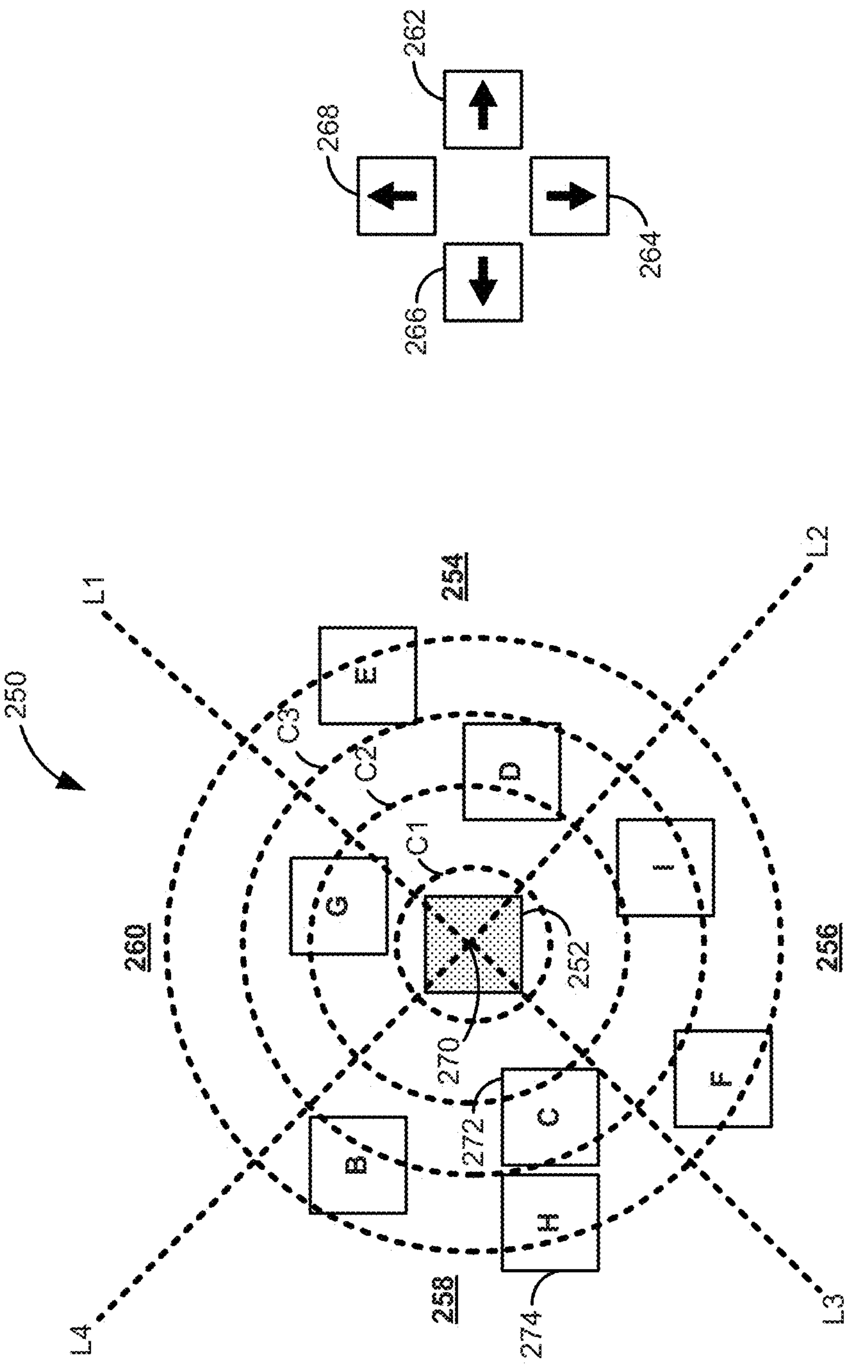

262
268
264
266
250
L1
L2
L3
L4
254
256
258
260
C1
C2
C3
E
D
I
G
F
C
B
H
252
270
272
274

FIG. 5

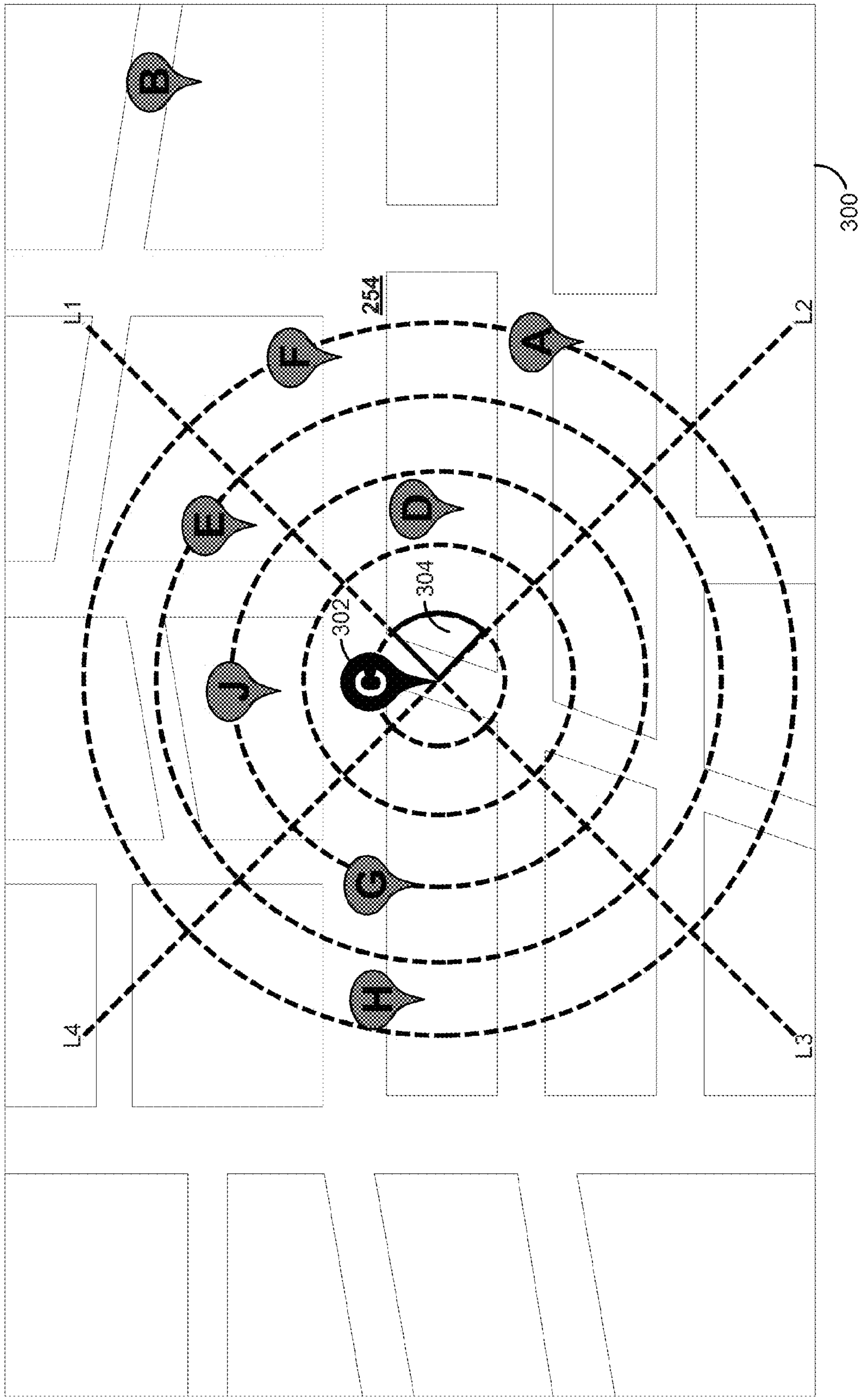


FIG. 6

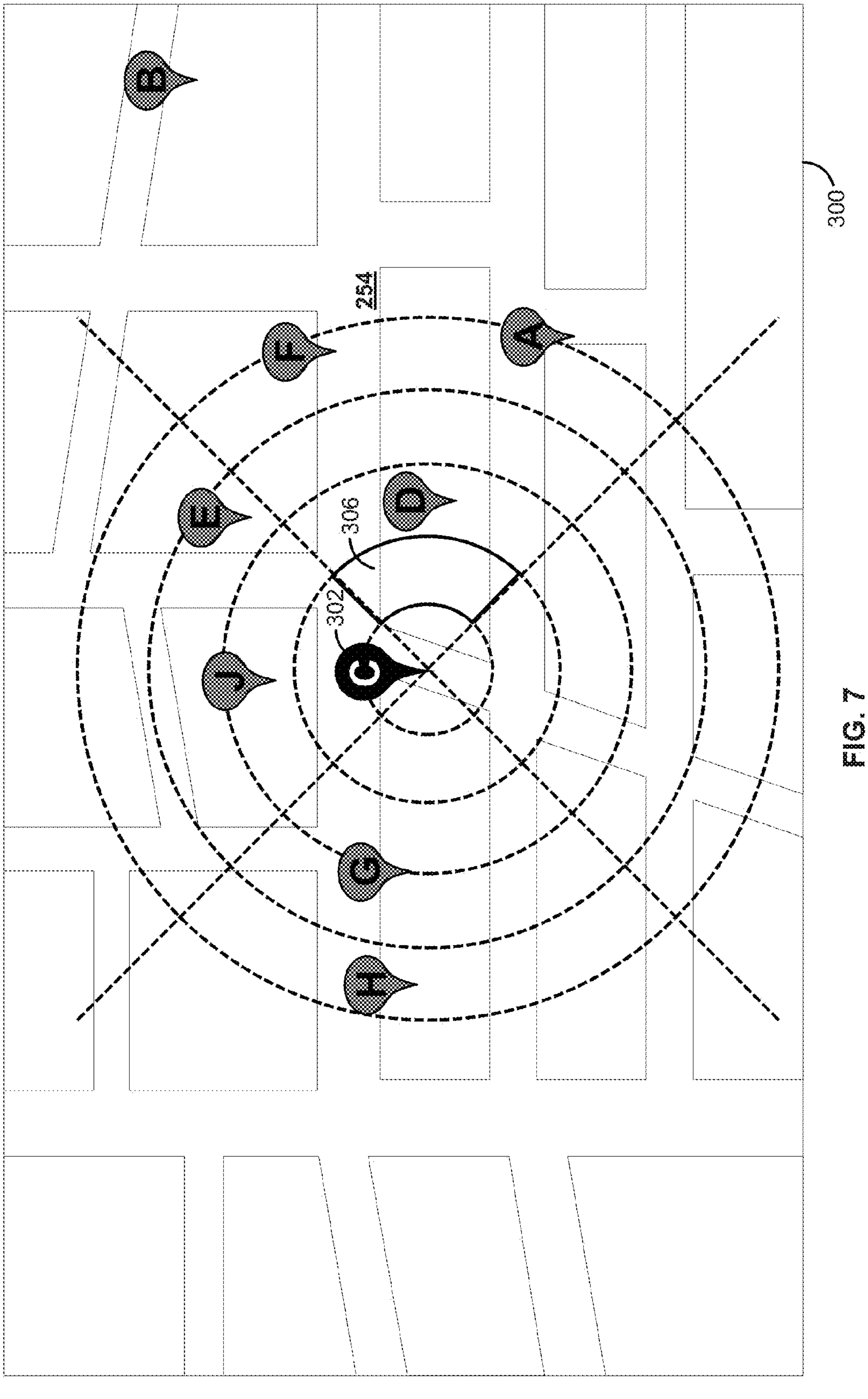


FIG. 7

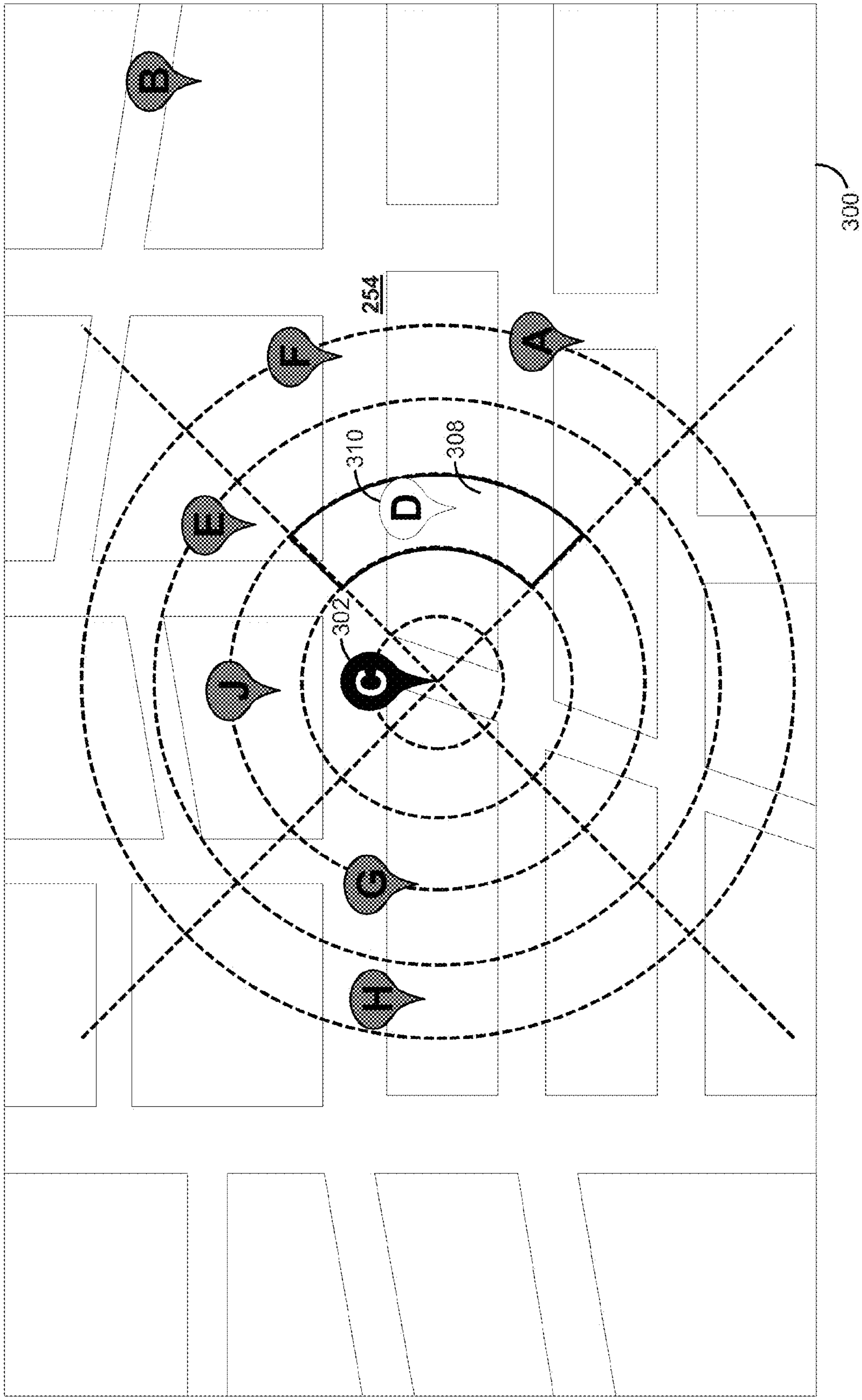


FIG. 8

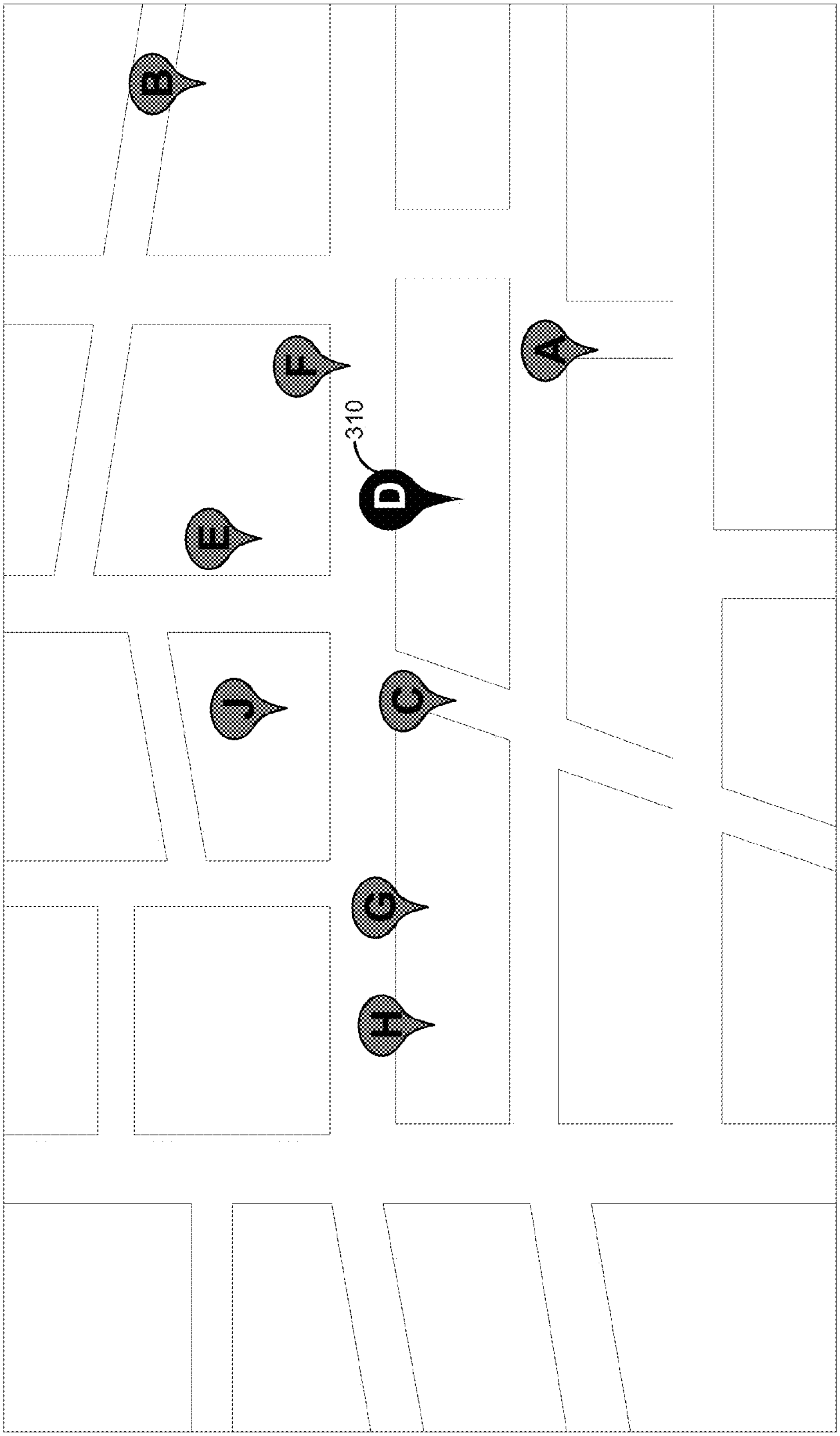


FIG. 9

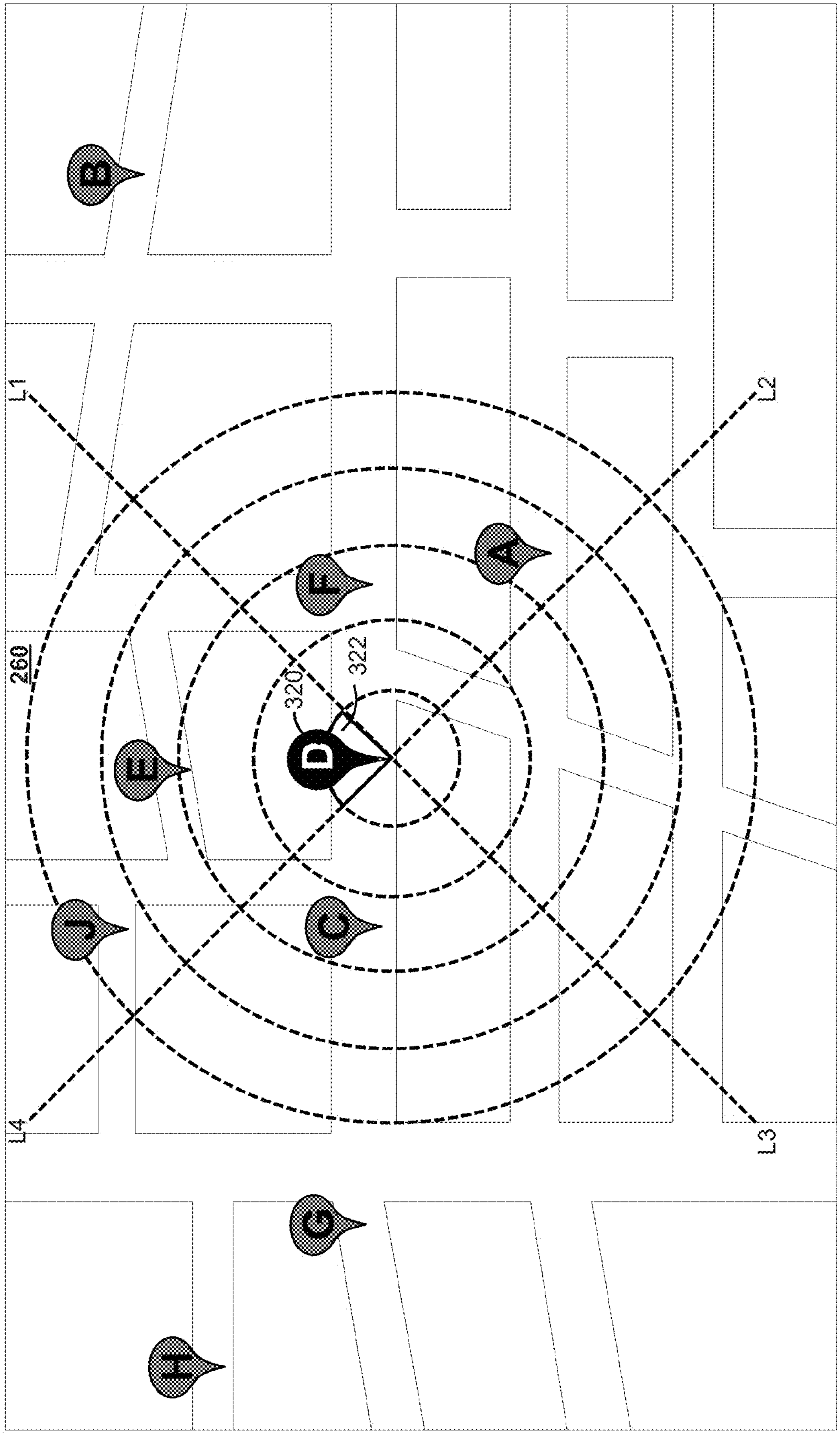


FIG. 10

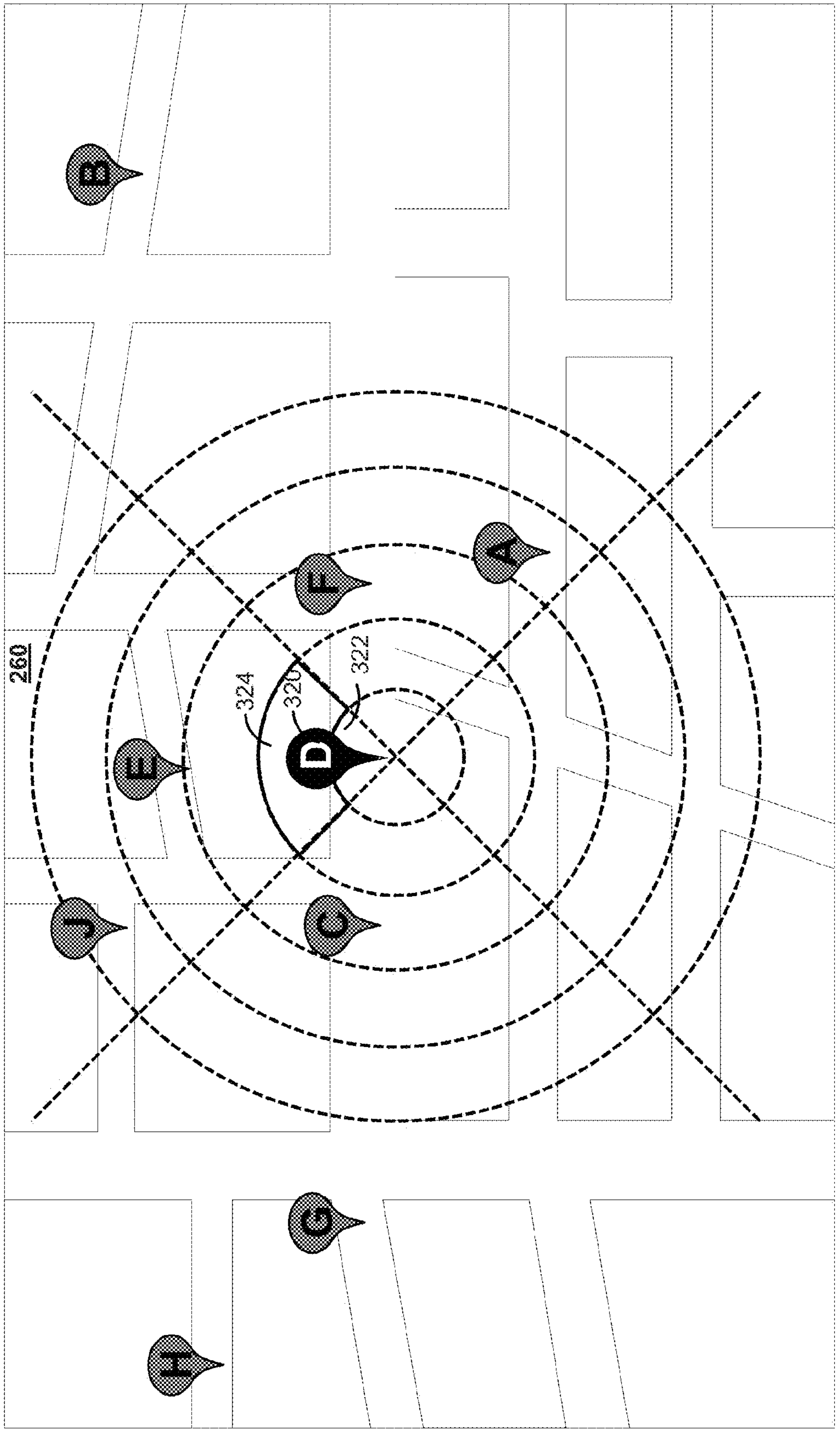


FIG. 11

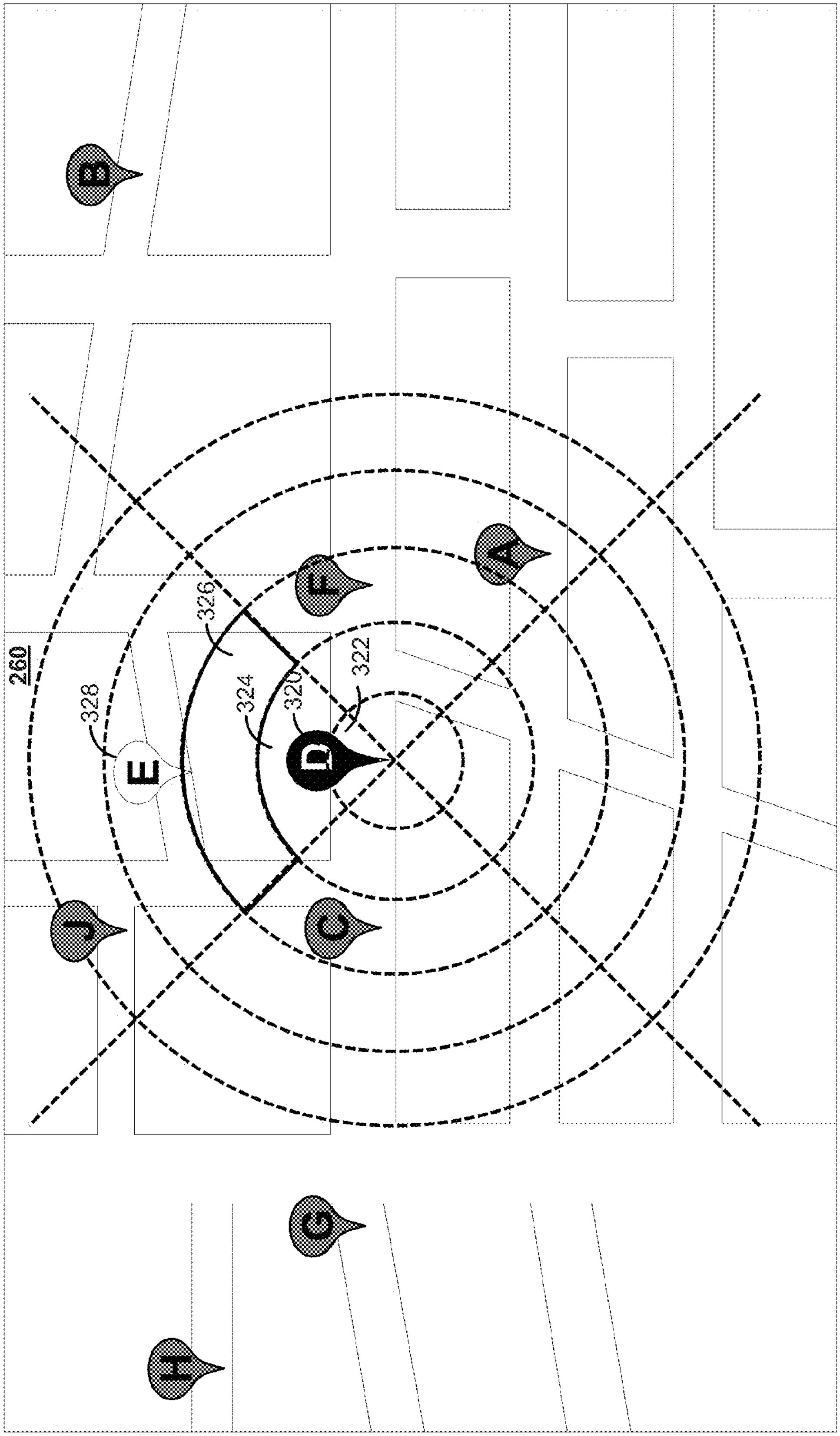


FIG. 12

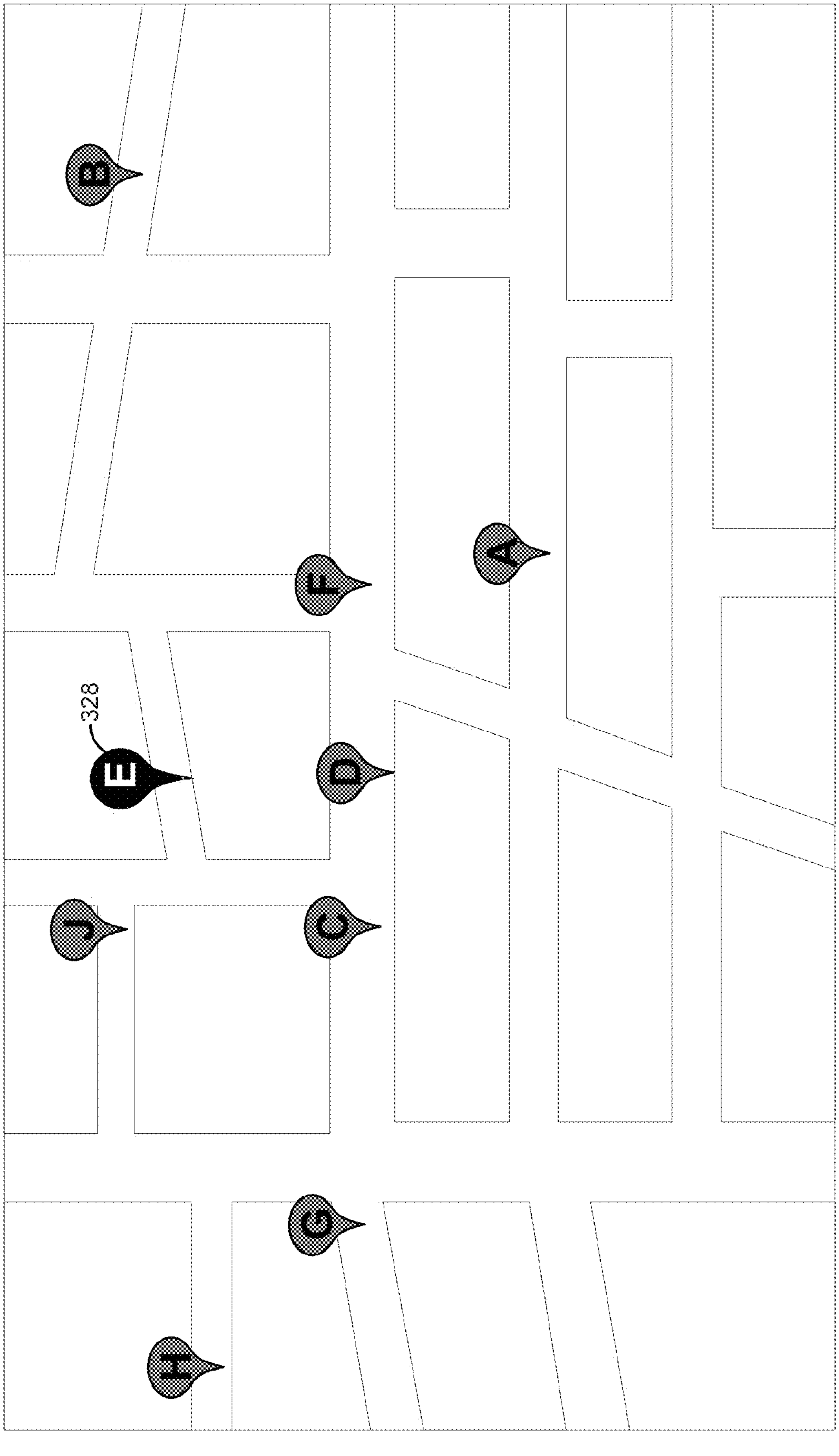


FIG. 13

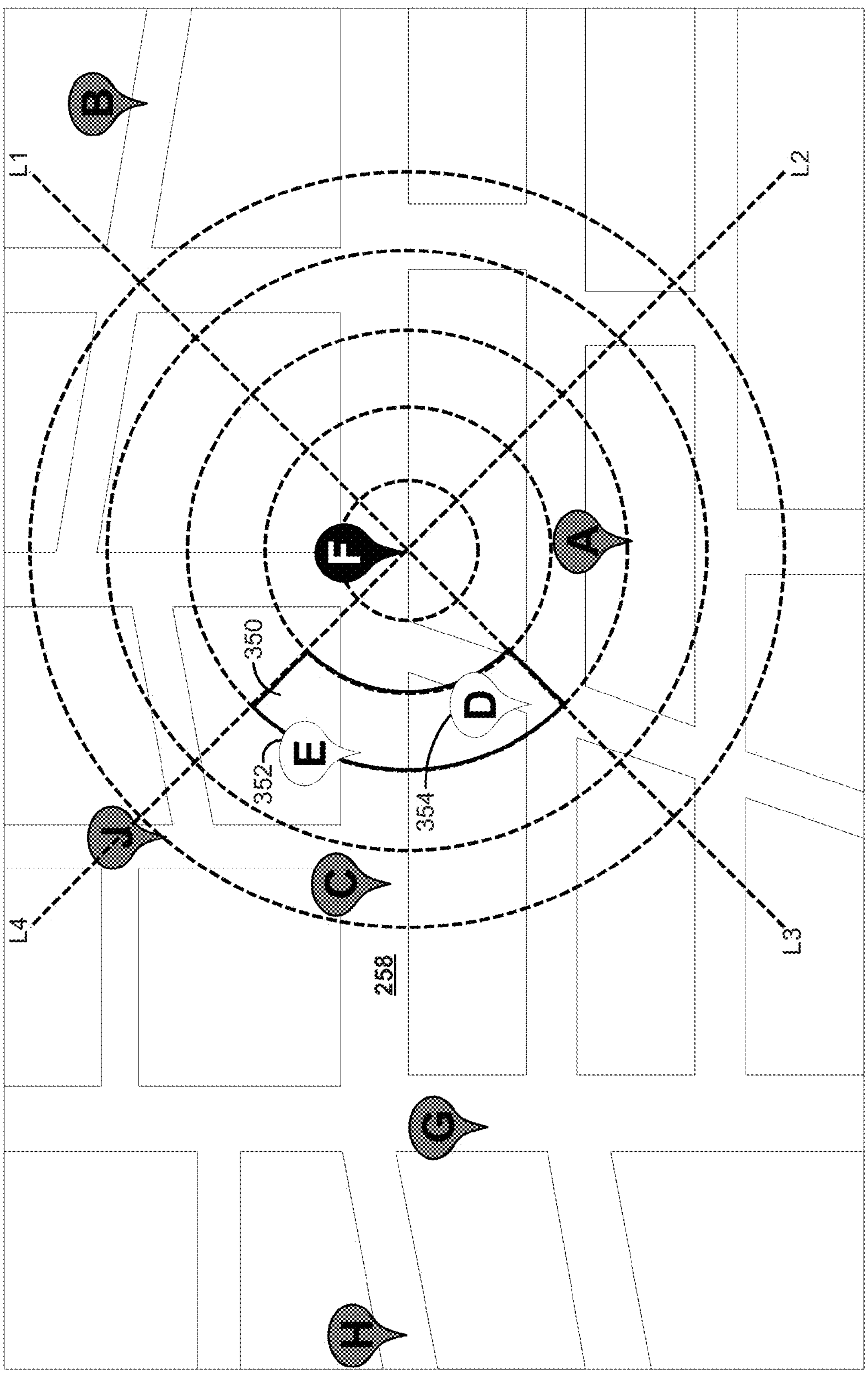


FIG. 14

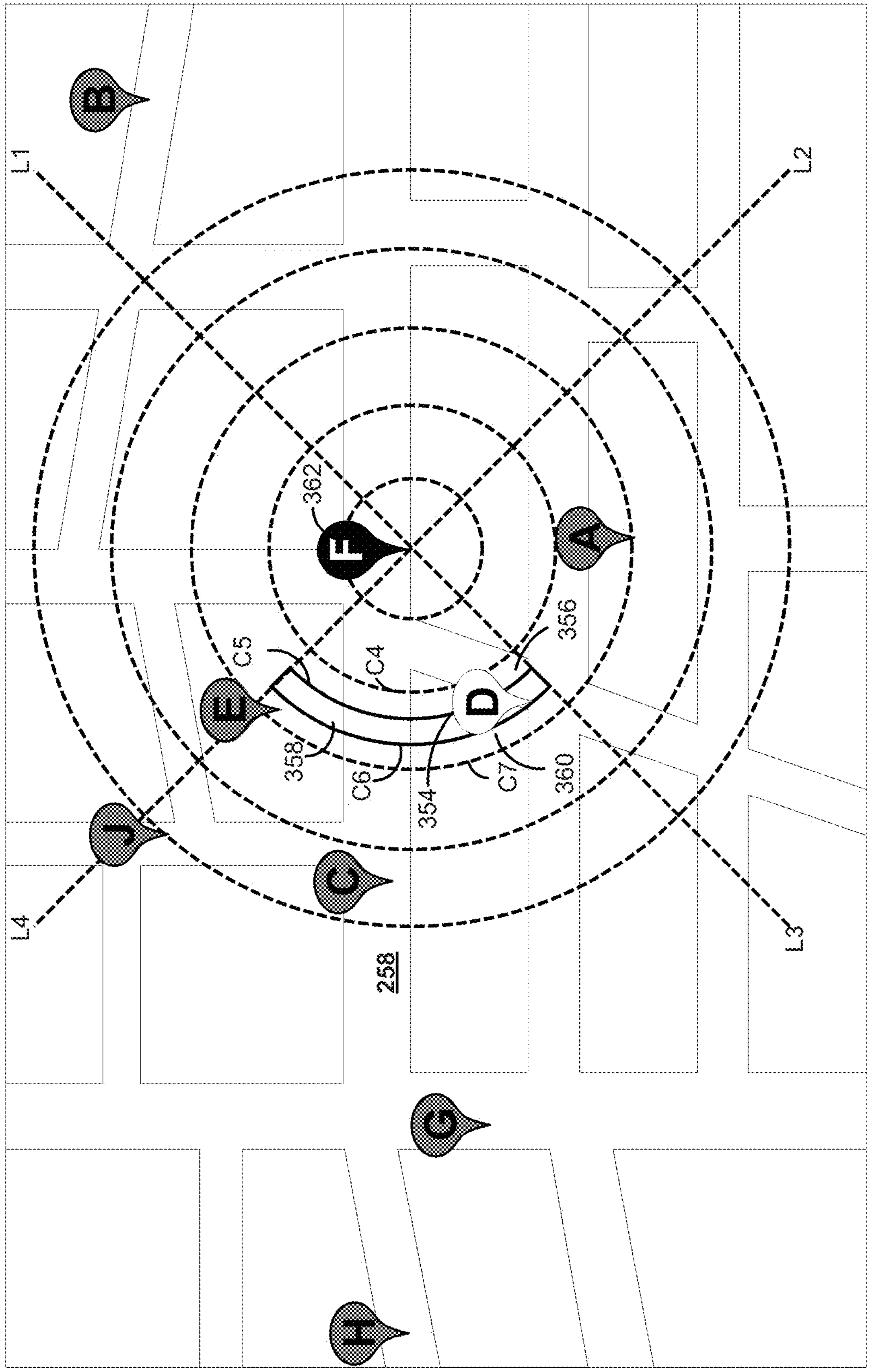


FIG. 15

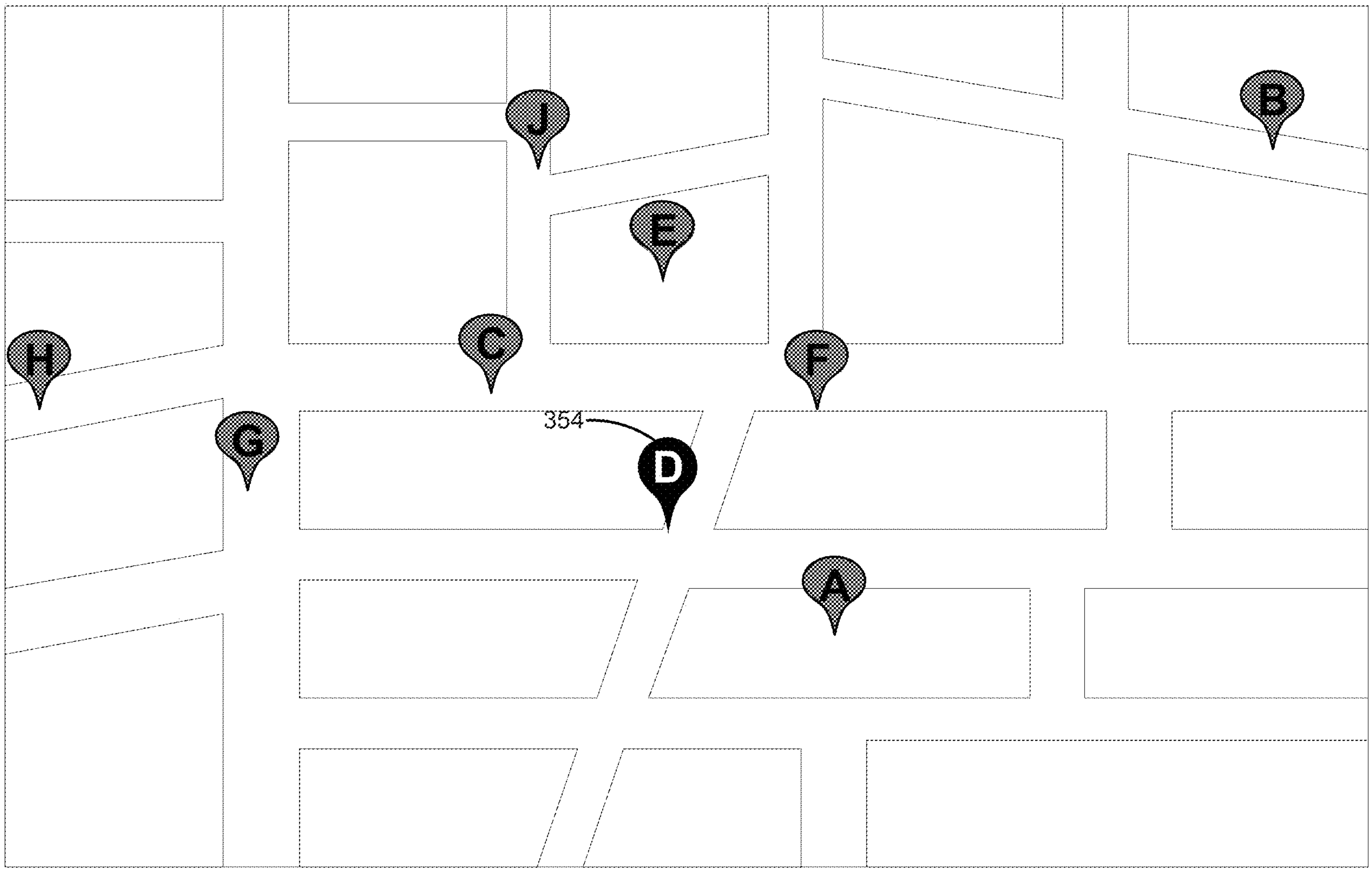


FIG. 16

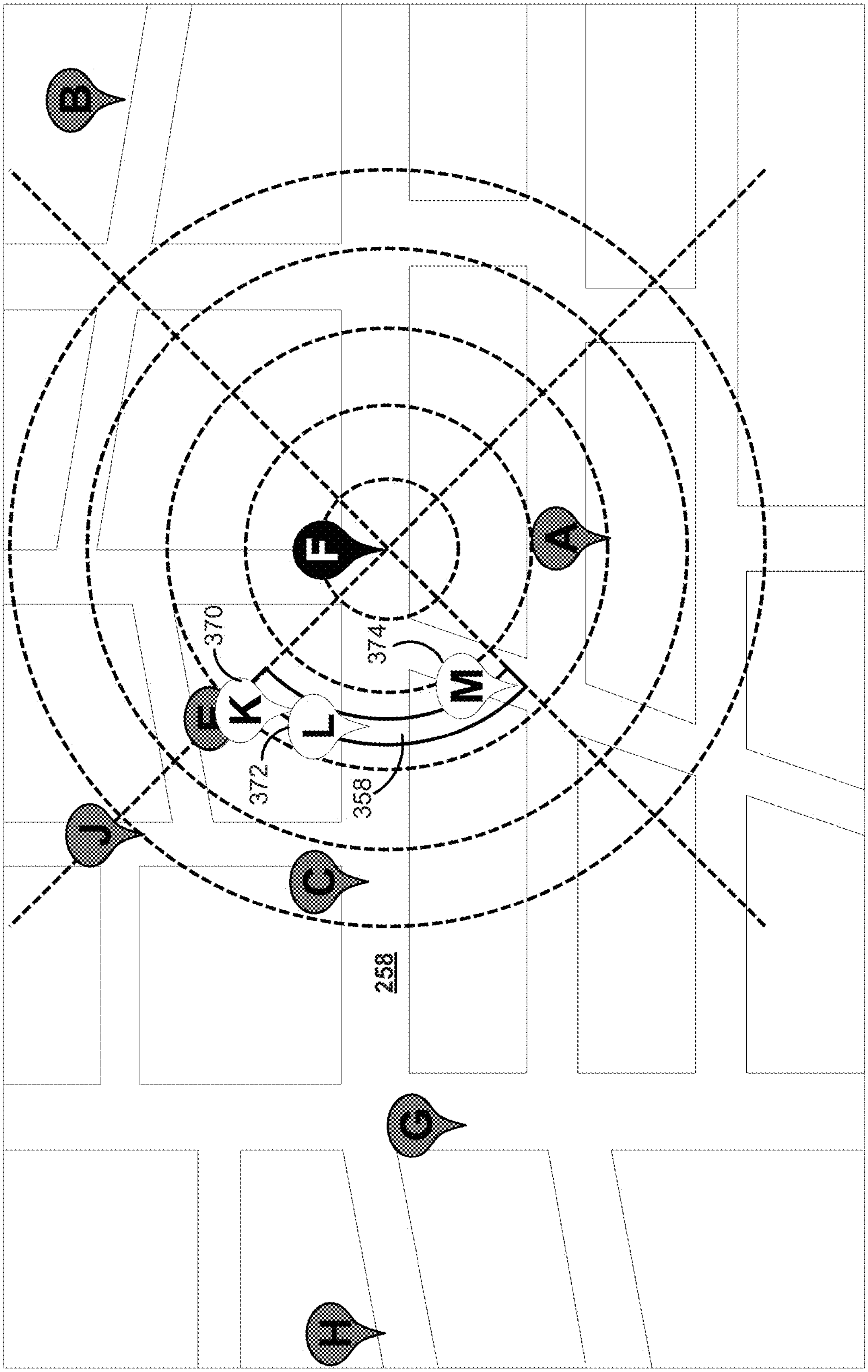


FIG. 17

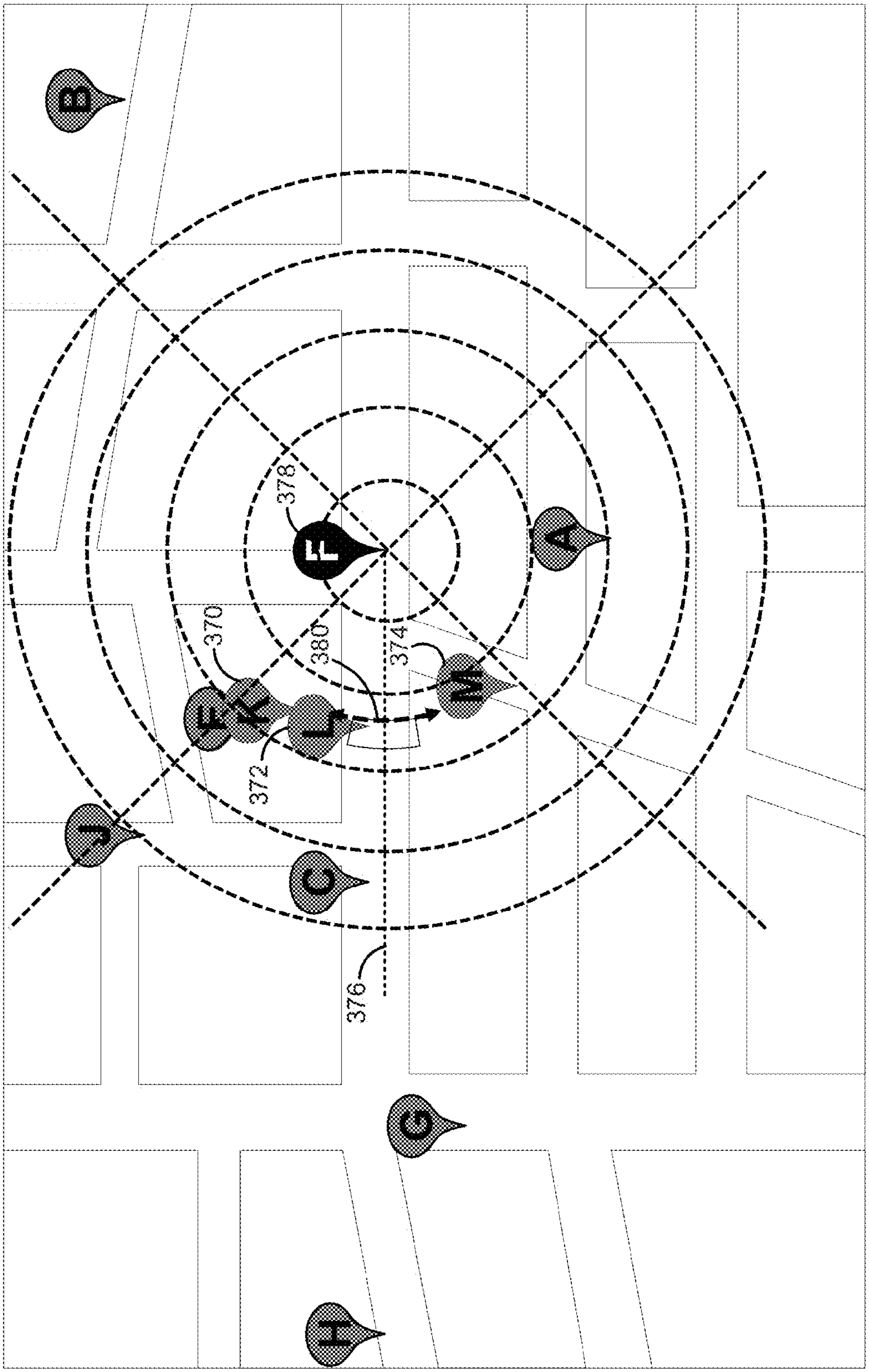


FIG. 18

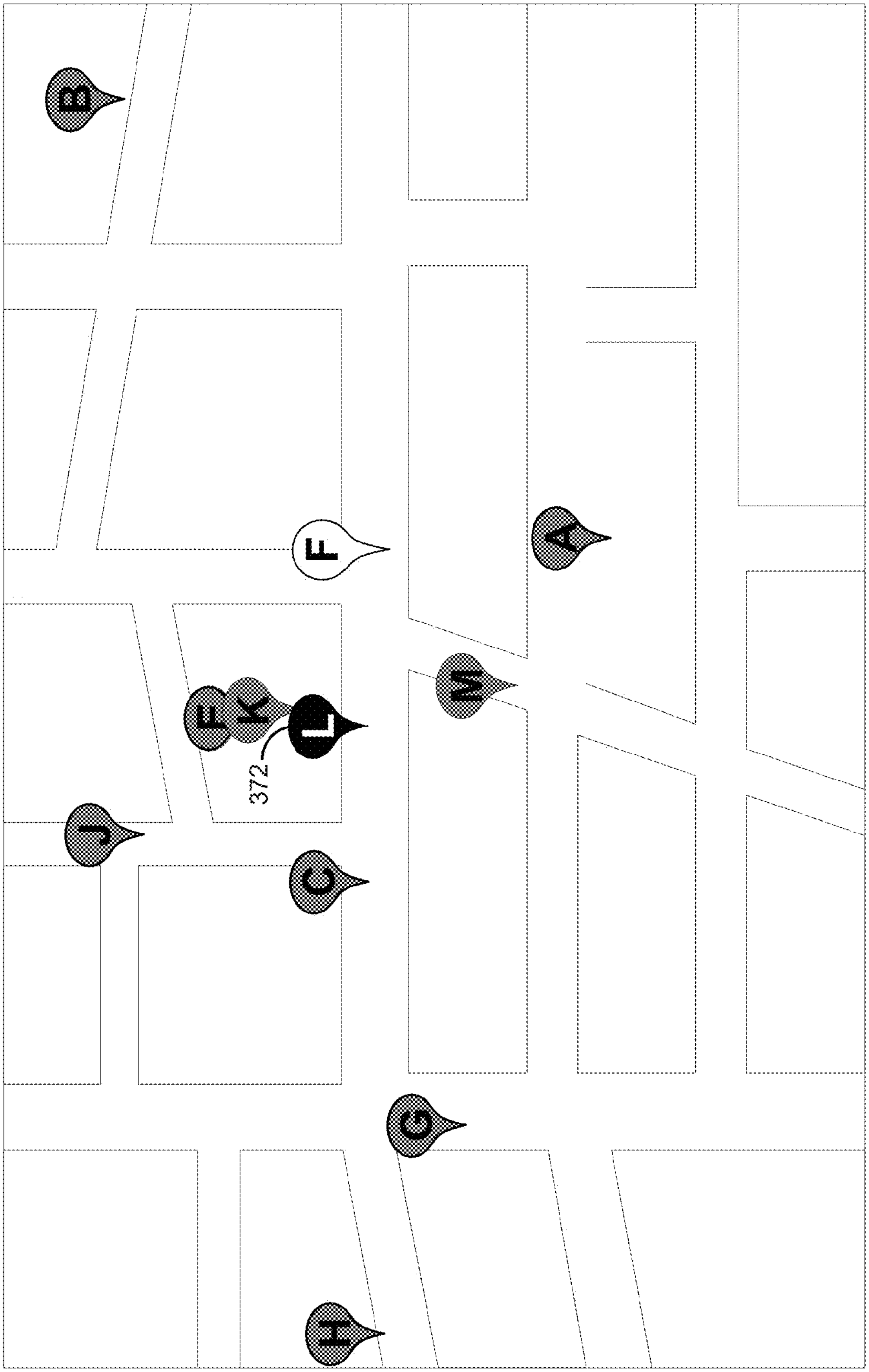


FIG. 19

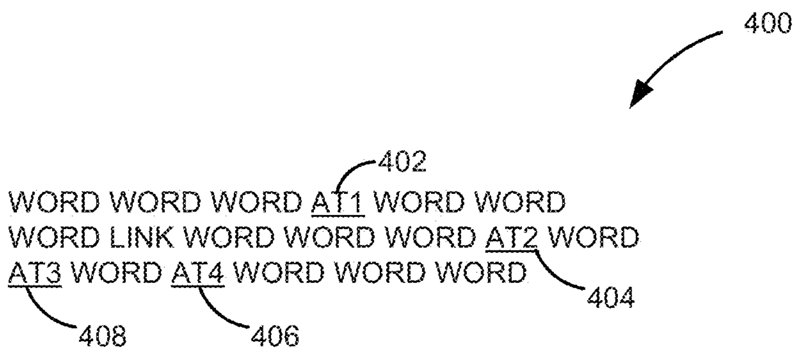

400
402
WORD WORD WORD AT1 WORD WORD
WORD LINK WORD WORD WORD AT2 WORD
AT3 WORD AT4 WORD WORD WORD
404
408
406

FIG. 20

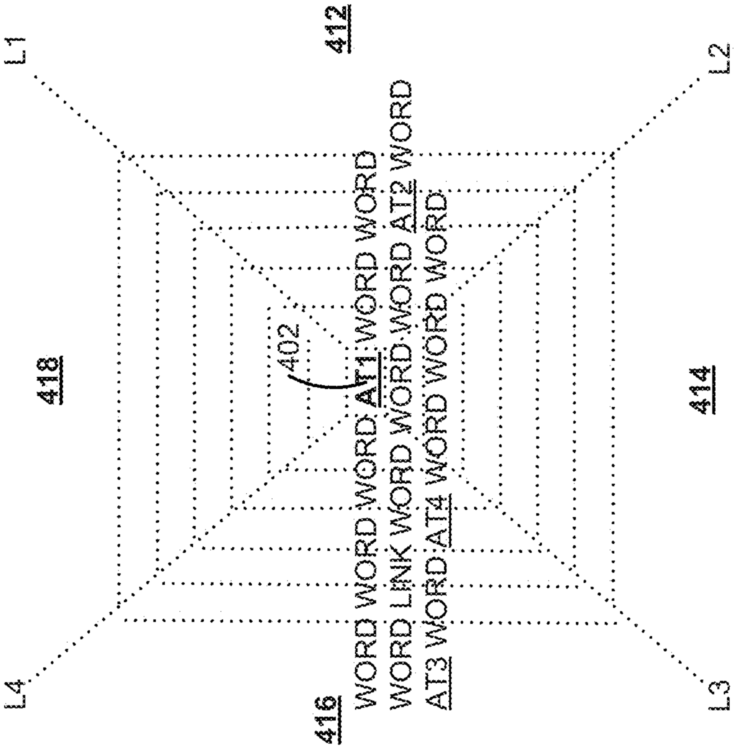

L1
412
L2
418
402
WORD WORD WORD AT1 WORD WORD
WORD LINK WORD WORD WORD AT2 WORD
AT3 WORD AT4 WORD WORD WORD
414
L4
416
L3

FIG. 21

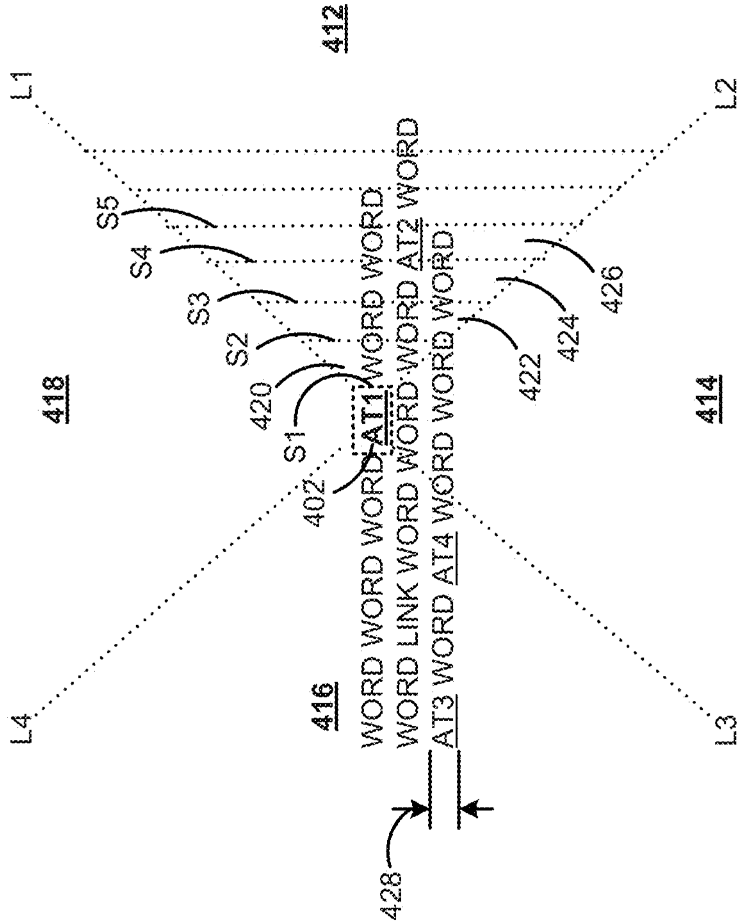

412
L1
L2
418
414
416
S5
S4
S3
S2
S1
420
402
422
424
426
WORD WORD WORD AT1 WORD WORD WORD
WORD LINK WORD WORD WORD AT2 WORD
AT3 WORD AT4 WORD WORD WORD
L4
L3
428

FIG. 22

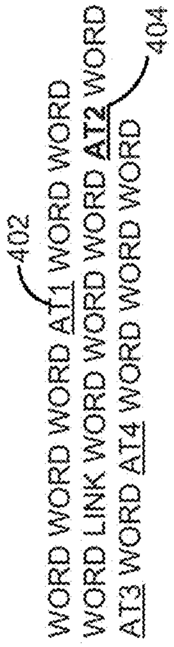

WORD WORD WORD AT1 WORD WORD
WORD LINK WORD WORD WORD AT2 WORD
AT3 WORD AT4 WORD WORD WORD
402
404

FIG. 23

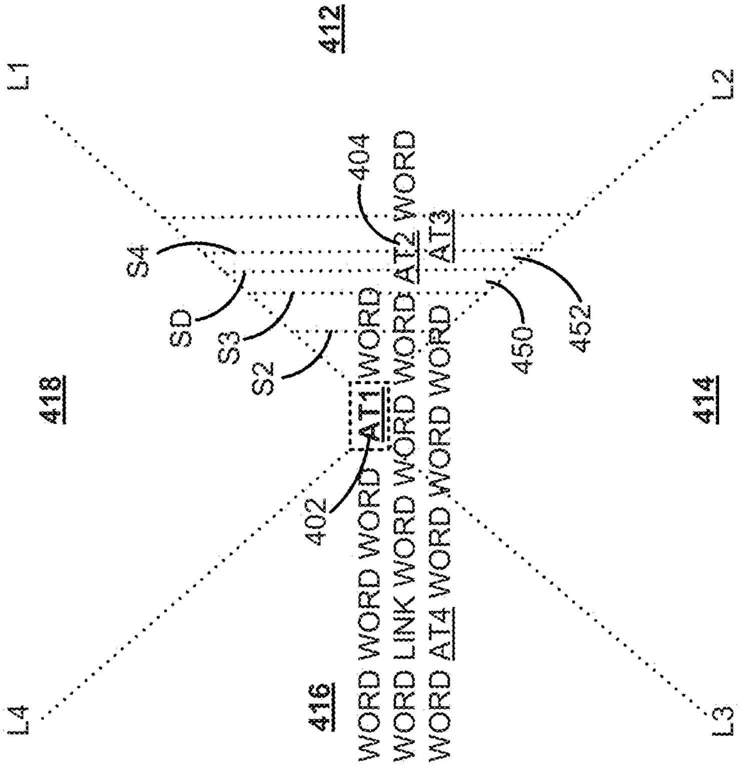

L1
412
L2
404
S4
SD
S3
S2
418
450
452
414
402
L4
416
L3
WORD WORD WORD AT1 WORD WORD
WORD LINK WORD WORD WORD AT2 WORD
WORD AT4 WORD WORD WORD AT3

FIG. 24

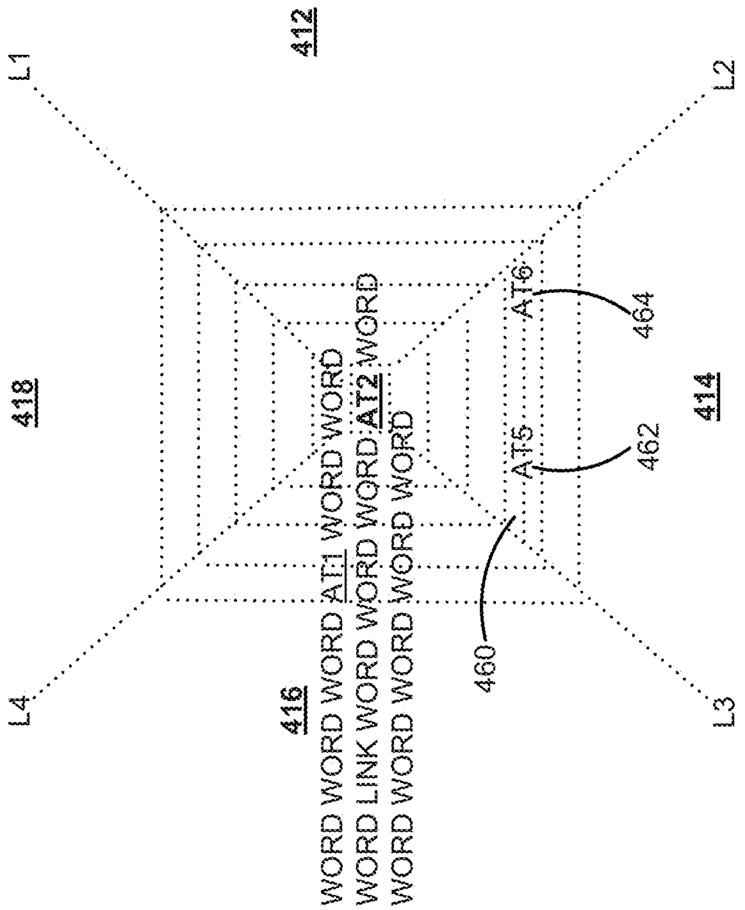

412
418
414
416
L1
L2
L3
L4
WORD WORD WORD AT1 WORD WORD WORD
WORD LINK WORD WORD WORD AT2 WORD
WORD WORD WORD WORD WORD WORD
AT5
AT6
460
462
464

FIG. 25

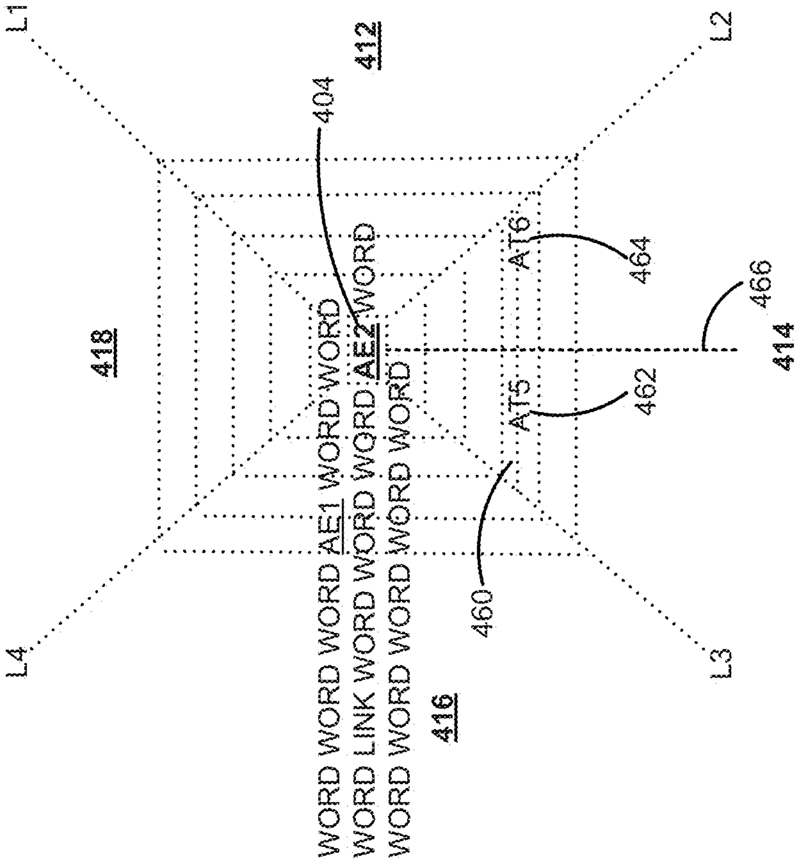

L1
L2
L3
L4
412
404
418
414
416
466
464
462
460
AT6
AT5
WORD WORD WORD AE1 WORD WORD WORD
WORD LINK WORD WORD WORD AE2 WORD
WORD WORD WORD WORD WORD

FIG. 26

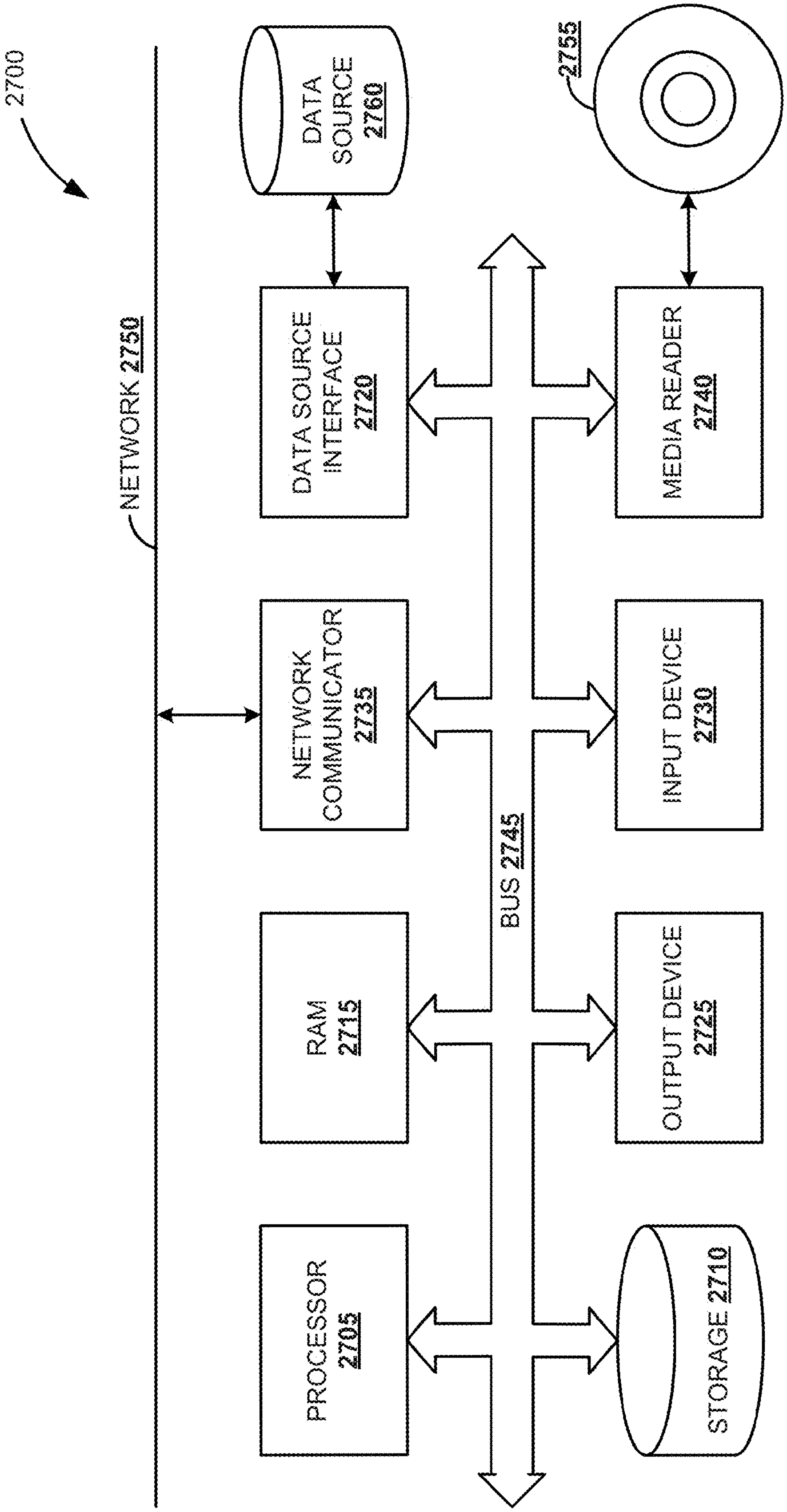

2700
NETWORK 2750
DATA SOURCE 2760
2755
DATA SOURCE INTERFACE 2720
MEDIA READER 2740
NETWORK COMMUNICATOR 2735
INPUT DEVICE 2730
BUS 2745
RAM 2715
OUTPUT DEVICE 2725
PROCESSOR 2705
STORAGE 2710

FIG. 27

KEYBOARD-BASED NAVIGATION OF A USER INTERFACE

FIELD

The field relates generally to user interface navigation. More particularly, the field relates to user interface navigation using a keyboard.

BACKGROUND

Mouse and keyboard are typical means for navigating a user interface (UI). A user can navigate a UI and reach a desired UI object using a mouse or a keyboard. A mouse can be more versatile for navigating a user interface. A user can simply move the cursor to a desired UI object using the mouse and make a selection. Keys such as up arrow key, down arrow key, left arrow key, and right arrow key are used for keyboard-based navigation. A combination of these keys can be used to navigate a UI and reach a desired UI object. Spreadsheets, tables, and other grid-type user interface environments can be conveniently navigated using a keyboard. However, keyboard-based navigation is not convenient and, in some cases, not possible for free or unstructured environments where UI objects are not in a grid-like arrangement. A user has to resort to a mouse to navigate such unstructured environments.

BRIEF DESCRIPTION OF THE DRAWINGS

The claims set forth the embodiments of the invention with particularity. The invention is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings in which like references indicate similar elements. The embodiments of the invention, together with its advantages, may be best understood from the following detailed description taken in conjunction with the accompanying drawings.

FIG. **1** illustrates a grid-type environment that can be navigated using a keyboard.

FIG. **2** illustrates another grid-type environment that can be navigated using a keyboard.

FIG. **3**A illustrates an unstructured UI environment, as an example.

FIG. **3**B is a block diagram of a map as an example of an unstructured UI environment.

FIG. **4** is a block diagram of a keyboard-based navigation method, according to one embodiment.

FIG. **5** illustrates quadrants and segments, according to one embodiment.

FIGS. **6-8** illustrate scanning of the segments in a quadrant to identify an object, according to one embodiment.

FIG. **9** illustrates selection of an object after identifying the object, according to one embodiment.

FIGS. **10-13** illustrate scanning of the segments in another quadrant to identify and select an object, according to one embodiment.

FIGS. **14-16** illustrate division of a segment and identification of an object when there are multiple objects in the segment, according to one embodiment.

FIGS. **17-19** illustrate identification of an object when there are multiple objects in a divided segment, according to one embodiment.

FIG. **20** illustrates an example of a feed update with active text objects.

FIG. **21** illustrates quadrants and segments, according to another embodiment.

FIGS. **22** and **23** illustrate the process of identification of an active text object, according to one embodiment.

FIG. **24** illustrate division of a segment when there are multiple active text objects in the segment, according to one embodiment.

FIGS. **25** and **26** illustrate identification of an active text object when there are multiple active text objects in a divided segment, according to one embodiment

FIG. **27** is a block diagram of an exemplary computer system according to one embodiment.

DETAILED DESCRIPTION

Embodiments of techniques for keyboard-based navigation of a user interface are described herein. In the following description, numerous specific details are set forth to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention can be practiced without one or more of the specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

Reference throughout this specification to "one embodiment", "this embodiment" and similar phrases, means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearances of these phrases in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

Grid type user interfaces can be conveniently navigated using a keyboard. A grid type user interface (UI) includes UI elements arranged in rows and columns or along vertical and horizontal lines. For example, referring to FIG. **1**, a spreadsheet **100** is a grid type UI that includes a plurality of cells. The cells are arranged in rows and columns. Directional keys such as up arrow key **102**, down arrow key **104**, left arrow key **106**, and right arrow key **108** are used to navigate the spreadsheet and select cells. If a user intends to select a cell that is above a currently selected cell, the up arrow key **102** is used. Therefore, it is straightforward to determine which direction the user intends to navigate and accordingly represent the movement on the spreadsheet.

FIG. **2** illustrates another grid-type UI **120**. This UI **120** is includes UI objects arranged in a grid. For example, the UI objects **122** in the quicksteps portion **124** are arranged along a vertical line. These UI objects **122** can be selected using the up arrow key **102** and the down arrow key **104**. The edit button **126**, duplicate button **128**, and delete button **130** are arranged along a horizontal line. A user can move between edit, duplicate, and delete buttons using the left arrow key **106** and the right arrow key **108** and select one of them. Therefore, it is easier to determine which direction the user intends to navigate in case of structured environments.

In unstructured environments, UI objects are scattered in a UI area without any specific pattern. These UI objects are not arranged in a grid or in any other sequence. FIG. **3**A illustrates UI objects in an unstructured environment **150**. Navigating such unstructured environments with a keyboard is not possible. Consider the UI objects A, E, and D in the unstructured environment **150**. Object E **152** and object D **154** are on the right side of the object A **156**. If a user selects the right arrow key, then it is not possible to determine which object the user is intending to select since both object E **152** and object D **154** are on the right side of the object A **156**. Similarly, if a user selects the left arrow key, then it is not possible to determine which object the user is intending to select since both object B **158** and object H **160** are on the left side of the object A **156**.

There are several types of unstructured environments that include scattered UI objects. One such unstructured environment is a map displayed on a UI, as shown in FIG. **3**B. A map **180** includes UI objects such as pins **182** which represent various locations. Navigating from one pin to another pin may not be possible using the keyboard since the pins **182** are scattered. The pins **182** are not in a grid-type or any sequential arrangement. The keyboard-based navigation method **200** is explained in reference to the map environment. However, it should be understood that the method can be applied to any unstructured environment for navigating between UI objects.

Although a pointing device such as a mouse can be more versatile in navigating a user interface, there are several situations where a keyboard is preferable. For example, some users, while working with a keyboard, may be more comfortable using the keyboard to navigate the UI instead of switching to a mouse. As another example, physically challenged users may also find a keyboard more comfortable and practical since operation of a mouse requires relatively more precision. A keyboard can be any type of keyboard on a computing device or any input device that includes keys to move up, down, left, and right in a user interface.

FIG. **4** illustrates an embodiment of the keyboard-based navigation method **200**. At **202**, an area around a first object displayed on a user interface is divided into quadrants. The user interface is an unstructured user interface **250** including a plurality of UI objects, as shown in FIG. **5**. The area around the first object **252** is divided into four equal quadrants, with the first object **252** as the center. In one embodiment, the area around the first object **252** is the user interface area around the first object **252**. The quadrants are defined by lines L**1**, L**2**, L**3**, and L**4** that originate from the first object **252**.

The central angle of each quadrant is 90 degrees. For example, a right-side quadrant **254** is the area between lines L**1** and L**2**. The angle between the lines L**1** and L**2** is 90 degrees, which is the central angle of the right-side quadrant **254**. Similarly, a lower quadrant **256** is the area between lines L**2** and L**3**, a left-side quadrant **258** is the area between lines L**3** and L**4**, and an upper quadrant **260** is the area between lines L**4** and L**1**. The quadrants divide the area around the first object **252** into four equal parts.

Each quadrant represents a direction corresponding to the first object **252**. The right-side quadrant **254** corresponds to the right-side direction of the first object **252**, the lower quadrant **256** corresponds to a direction below the first object **252**, the left-side quadrant **258** corresponds to the left side direction of the first object **252**, and the upper quadrant **260** corresponds to a direction above the first object **252**. The right-side quadrant **254** is associated with the right arrow key **262**, the lower quadrant **256** is associated with the down arrow key **264**, the left-side quadrant **258** is associated with the left arrow key **266**, and the upper quadrant **260** is associated with the up arrow key **268**. Therefore, if a user selects a right arrow key **262**, the right-side quadrant **254** would be identified.

Each quadrant is divided into one or more segments. The segments are concentric. For example, a first or center segment of the right-side quadrant **254** is the area encompassed by the lines L**1** and L**2** and the curve C**1**. A second segment of the right-side quadrant **254** is the area encompassed by the lines L**1** and L**2** and the curves C**1** and C**2**. A third segment of the right-side quadrant **254** is the area encompassed by the lines L**1** and L**2** and the curves C**2** and C**3**. These segments of

the right-side quadrant are concentric in that the curves C**1**, C**2**, and C**3** have the same center **270** but different radii.

The curves C**1**, C**2**, and C**3** are parts of circles with the same center **270**. For example, the curve C**1** is a quarter circle extending from the line L**1** to line L**2**. Similarly, the curve C**2** is also a quarter circle extending from the line L**1** to line L**2**, but has a larger radius than the curve C**1**. If the first object represents a point, then the center **270** of the curves is the location of the first object. In another embodiment, if the first object is not a point, then this center **270** can be the center of a boundary (e.g., a rectangle) that encompasses the first object.

In one embodiment, the segments are divided such that the width of the segments is equal to the shortest of the distances between the objects. Distances between pairs of the objects can be determined and the shortest of such distances is used for the width of the segments. Consider that the distance between the object C **272** and the object H **274** is the least among distances between any other pair of the objects. This distance between the object C **272** and the object H **274** is then used as the width for the segments. Therefore, the segments have equal width. The width of the first segment of the right-side quadrant **254** is the distance between the center (e.g., first object) and the curve C**1**. The width of the second segment of the right-side quadrant **254** is the distance between the curve C**1** and the curve C**2**. The width of the third segment of the right-side quadrant **254** is the distance between the curve C**2** and the curve C**3**.

Referring to FIG. **6**, considering the example of a map **300**, the first object is a first pin **302** indicating a location. The map also includes several other pins indicating other locations. The first pin (pin 'C') **302** can be a pin that is currently selected. This selection can be a default selection when the map is first rendered based on a user request. The area around the first pin is divided into four quadrants by lines L**1**, L**2**, L**3**, and L**4** and each quadrant is divided into segments, as explained previously.

Referring back to FIG. **4**, in response to a keystroke indicating a first direction, a first quadrant corresponding to the first direction is identified at **204**. The keystroke includes up, down, left, or right direction with respect to the first object. For example, referring to FIG. **6**, when a user selects a right arrow key or any other key indicating a right-side direction, a right-side quadrant **254** is identified. The right-side quadrant **254** is the quadrant that corresponds to a right-side direction with respect to the first pin **302**. This right-side quadrant **254** is the area between the lines L**1** and L**2**.

Referring back to FIG. **4**, once the first quadrant is identified, the segments in the first quadrant are scanned sequentially at **206**. The segments are scanned to identify a second object that is closest to the first object in the first quadrant. For example, referring to FIG. **6**, after the right-side quadrant **254** is identified, the segments in the right-side quadrant **254** are scanned sequentially starting from the first or center segment **304** to identify a second pin that is closest to the first pin **302**. The first segment **304** is scanned first to determine if a second pin lies in the right-side quadrant **254**. If the second pin represents a point, then it is determined whether that point lies within the first segment **304**. In another embodiment, if the second pin or object does not represent a point, then it is determined whether a boundary of the second object overlaps with the first segment **304**.

In the example of FIG. **6**, the first segment **304** does not include any pins. Therefore, as shown in FIG. **7**, a second segment **306** of the right-side quadrant **254** is then scanned to determine if there are any pins in the second segment **306**. Since there are no pins in the second segment **306**, a third segment **308** is then scanned as shown in FIG. **8**. The second pin **310** lies in the third segment **308** and is therefore identified. This second pin **310** is closest to the first pin **302** in the right-side quadrant **254**. Referring back to FIG. **4**, once identified, the second pin **310** is selected at **208**. This selection can be represented by changing a display attribute such as color, size, etc., of the second pin **310**, as shown in FIG. **9**.

As another example, if a user selects an up arrow key, then an upper quadrant **260** is identified as shown in FIG. **10**. The upper quadrant **260** is the area above the first object **320** between lines L**4** and L**1**. The first segment **322** of the upper quadrant **260** is scanned to determine if there a second pin within the first segment **322**. Since the first segment **322** does not include any pin, a second segment **324** is then scanned, as shown in FIG. **11**. The second segment **324** also does not include any pin. Therefore, the third segment **326** is then scanned, as shown in FIG. **12**. The second pin **328** lies in the third segment **326** and is identified. This second pin **328** is closest to the first pin **320** in the upper quadrant **260**. Following, which the second pin **328** is selected and this selection is represented on the user interface, as shown in FIG. **13**.

There can be scenarios in which a segment includes multiple objects. In such scenarios, the segment including multiple pins is divided into smaller segments. For example, referring to FIG. **14**, the third segment **350** of the left-side quadrant **258** includes two pins, namely, pin E **352** and pin D **354**. The third segment **350** is concentrically divided into three segments as shown in FIG. **15**. The third segment **350** is the area defined between the curves C**4** and C**7** and the lines L**3** and L**4**. A first divided segment **356** is the area defined between the curves C**4** and C**5** and the lines L**3** and L**4**. A second divided segment **358** is the area defined between the curves C**5** and C**6** and the lines L**3** and L**4**. A third divided segment **360** is the area defined between the curves C**6** and C**7** and the lines L**3** and L**4**. Curves C**4**, C**5**, C**6** and C**7** are concentric. These divided segments **356**, **358**, and **360** are then scanned sequentially to identify the second pin that is closest to the first pin **362** in the left-side quadrant **258**. The first divided segment **356** does not include any pins. Therefore, the second divided segment **358** is then scanned. The second pin **354**, i.e. pin D, is in the second divided segment **358**. The second pin **354** is therefore identified and selected as shown in FIG. **16**.

Referring to FIG. **17**, in one embodiment, even after dividing a segment, a divided segment can included more than one object. For example, the second divided segment **358** of the left-side quadrant **258** includes pin K **370**, pin L **372**, and pin M **374**. In such cases, referring to FIG. **18**, a center line **376** that divides the left-side quadrant **258** is used as a reference for selecting a second pin that is closest to the first pin F **378** in the left-side quadrant **258**. A pin that is in the second divided segment **358** and closest to the center line **376** is identified as the second pin. Pin L **372** is the closest to the center line **376** and is therefore selected as the second pin. In one embodiment, the second pin **372** is the pin that has the least circle-distance from the center line **376**. In another embodiment, the divided segment in which the pins lie is scanned from the center line **376** (as represented by the shaded region) along the curvature **380** of the divided segment until a pin is encountered. The first encountered pin is the second pin **372**. The selection of the second pin **372** is then presented on the user interface as shown in FIG. **19**.

Some unstructured environments can include active text objects. An example of such environments is a feed update **400** as shown in FIG. **20**. The feed update **400** includes active text objects **402**, **404**, **406**, and **408** along with other text. The active text objects **402-408** are not in a grid-type arrangement and a user has to typically use a mouse to select an active text object. The active text objects **402-408** can be links. The feed update can also one or more visual objects to perform actions such as to flag, set as favorite, like/dislike, etc. The keyboard-based navigation method **200** described above in reference to map environment can be similarly used to navigate between the active text objects **402-408**. The area around a first active text object **402** is divided into four equal quadrants, with the first active text object **402** as the center, as shown in FIG. **21**. The first active text object **402** can be the active text object that occurs first in the feed update **400**. The quadrants are defined by lines L**1**, L**2**, L**3**, and L**4** that originate from the first active text object. The central angle of each quadrant is 90 degrees. The right-side quadrant **412** is the area between lines L and L**2**, the lower quadrant **414** is the area between lines L**2** and L**3**, the left-side quadrant **416** is the area between lines L**3** and L**4**, and the upper quadrant **418** is the area between lines L**4** and L**1**.

The right-side quadrant **412** corresponds to the right-side direction of the first object **402**, the lower quadrant **414** corresponds to a direction below the first object **402**, the left-side quadrant **416** corresponds to the left side direction of the first object **402**, and the upper quadrant **418** corresponds to a direction above the first object **402**. The right-side quadrant **412** is associated with a right arrow key, the lower quadrant **414** is associated with a down arrow key, the left-side quadrant **416** is associated with a left arrow key, and the upper quadrant **418** is associated with an up arrow key.

Each quadrant is divided into one or more segments. The segments in each quadrant are parallel. For example, referring to FIG. **22**, a first segment **420** of the right-side quadrant **412** is the area defined by the lines L**1**, L**2**, S**1**, and S**2**. A second segment **422** of the right-side quadrant **412** is the area encompassed by the lines L**1**, L**2**, S**2**, and S**3**. A third segment **424** of the right-side quadrant **412** is the area encompassed by the lines L**1**, L**2**, S**3**, and S**4**. A fourth segment **426** of the right-side quadrant **412** is the area encompassed by the lines L**1**, L**2**, S**4**, and S**5**. The lines S**1** to S**5** are parallel. In one embodiment, the segments are divided such that the width of the segments is equal to the line height **428** of the text objects in the feed update.

When a user selects a right arrow key, the right-side quadrant **412** is identified. The first segment **420** is scanned first to determine if a second active text object lies in the right-side quadrant **412**. Since the first segment **420** does not include any active text objects, the second segment **422** is then scanned. Since there are no active text objects in the second segment **422**, the third segment **424** is then scanned. The second active text object **404** lies in the third segment **424** and is therefore identified. The second active text object **404** is then selected, as shown in FIG. **23**.

If a segment includes multiple active text objects, then the segment is divided into smaller segments. For example, referring to FIG. **24**, the third segment **424** of the right-side quadrant **412** includes two active text objects. The third segment is divided into two segments. A first divided segment **450** is the area defined between the lines S**3** and SD and the lines L**1** and L**2**. A second divided segment **452** is the area defined between the lines SD and S**4** and the lines L**1** and L**2**. These divided segments **450** and **452** are scanned sequentially to identify an active text object that is closest to the first active text object **402** in the right-side quadrant **412**. The first divided segment **450** includes the second active text object **404**, which is therefore identified and selected.

Referring to FIG. **25**, in one embodiment, even after dividing a segment, a divided segment can included more than one active text object. For example, a divided segment **460** of the lower quadrant **414** includes two active text objects **462** and **464**. In such cases, referring to FIG. **26**, a center line **466** that divides the left-side quadrant **414** is used as a reference for selecting a second active text object that is closest to the first active text object **404** in the left-side quadrant **414**. An active text object that is in the divided segment **460** and closest to the center line **466** is identified as the second active text object. The active text object AT**5** **462** is the closest to the center line **466** and is therefore selected as the second active text object. In one embodiment, if there are multiple active text objects within same distance from the center line, left most of the active text objects is identified as the second active text object. For example, if the active text objects AT**5** **462** and AT**6** **464** are within the same distance from the center line **466**, then the active text object AT**5** **462** is selected because it is the left most.

Some embodiments of the invention may include the above-described methods being written as one or more software components. These components, and the functionality associated with each, may be used by client, server, distributed, or peer computer systems. These components may be written in a computer language corresponding to one or more programming languages such as, functional, declarative, procedural, object-oriented, lower level languages and the like. They may be linked to other components via various application programming interfaces and then compiled into one complete application for a server or a client. Alternatively, the components maybe implemented in server and client applications. Further, these components may be linked together via various distributed programming protocols. Some example embodiments of the invention may include remote procedure calls being used to implement one or more of these components across a distributed programming environment. For example, a logic level may reside on a first computer system that is remotely located from a second computer system containing an interface level (e.g., a graphical user interface). These first and second computer systems can be configured in a server-client, peer-to-peer, or some other configuration. The clients can vary in complexity from mobile and handheld devices, to thin clients and on to thick clients or even other servers.

The above-illustrated software components are tangibly stored on a computer readable storage medium as instructions. The term “computer readable storage medium” should be taken to include a single medium or multiple media that stores one or more sets of instructions. The term “computer readable storage medium” should be taken to include any physical article that is capable of undergoing a set of physical changes to physically store, encode, or otherwise carry a set of instructions for execution by a computer system which causes the computer system to perform any of the methods or process steps described, represented, or illustrated herein. Examples of computer readable storage media include, but are not limited to: magnetic media, such as hard disks, floppy disks, and magnetic tape; optical media such as CD-ROMs, DVDs and holographic devices; magneto-optical media; and hardware devices that are specially configured to store and execute, such as application-specific integrated circuits (“ASICs”), programmable logic devices (“PLDs”) and ROM and RAM devices. Examples of computer readable instructions include machine code, such as produced by a compiler, and files containing higher-level code that are executed by a computer using an interpreter. For example, an embodiment of the invention may be implemented using Java, C++, or other object-oriented programming language and development tools. Another embodiment of the invention may be implemented in hard-wired circuitry in place of, or in combination with machine readable software instructions.

FIG. **27** is a block diagram of an exemplary computer system **2700**. The computer system **2700** includes a processor **2705** that executes software instructions or code stored on a computer readable storage medium **2755** to perform the above-illustrated methods of the invention. The computer system **2700** includes a media reader **2740** to read the instructions from the computer readable storage medium **2755** and store the instructions in storage **2710** or in random access memory (RAM) **2715**. The storage **2710** provides a large space for keeping static data where at least some instructions could be stored for later execution. The stored instructions may be further compiled to generate other representations of the instructions and dynamically stored in the RAM **2715**. The processor **2705** reads instructions from the RAM **2715** and performs actions as instructed. According to one embodiment of the invention, the computer system **2700** further includes an output device **2725** (e.g., a display) to provide at least some of the results of the execution as output including, but not limited to, visual information to users and an input device **2730** to provide a user or another device with means for entering data and/or otherwise interact with the computer system **2700**. Each of these output devices **2725** and input devices **2730** could be joined by one or more additional peripherals to further expand the capabilities of the computer system **2700**. A network communicator **2735** may be provided to connect the computer system **2700** to a network **2750** and in turn to other devices connected to the network **2750** including other clients, servers, data stores, and interfaces, for instance. The modules of the computer system **2700** are interconnected via a bus **2745**. Computer system **2700** includes a data source interface **2720** to access data source **2760**. The data source **2760** can be accessed via one or more abstraction layers implemented in hardware or software. For example, the data source **2760** may be accessed by network **2750**. In some embodiments the data source **2760** may be accessed via an abstraction layer, such as, a semantic layer.

A data source is an information resource. Data sources include sources of data that enable data storage and retrieval. Data sources may include databases, such as, relational, transactional, hierarchical, multi-dimensional (e.g., OLAP), object oriented databases, and the like. Further data sources include tabular data (e.g., spreadsheets, delimited text files), data tagged with a markup language (e.g., XML data), transactional data, unstructured data (e.g., text files, screen scrapings), hierarchical data (e.g., data in a file system, XML data), files, a plurality of reports, and any other data source accessible through an established protocol, such as, Open DataBase Connectivity (ODBC), produced by an underlying software system (e.g., ERP system), and the like. Data sources may also include a data source where the data is not tangibly stored or otherwise ephemeral such as data streams, broadcast data, and the like. These data sources can include associated data foundations, semantic layers, management systems, security systems and so on.

In the above description, numerous specific details are set forth to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however that the invention can be practiced without one or more of the specific details or with other methods, components, techniques, etc. In other instances, well-known operations or structures are not shown or described in details to avoid obscuring aspects of the invention.

Although the processes illustrated and described herein include series of steps, it will be appreciated that the different embodiments of the present invention are not limited by the illustrated ordering of steps, as some steps may occur in different orders, some concurrently with other steps apart from that shown and described herein. In addition, not all illustrated steps may be required to implement a methodology in accordance with the present invention. Moreover, it will be appreciated that the processes may be implemented in association with the apparatus and systems illustrated and described herein as well as in association with other systems not illustrated.

The above descriptions and illustrations of embodiments of the invention, including what is described in the Abstract, is not intended to be exhaustive or to limit the invention to the precise forms disclosed. While specific embodiments of, and examples for, the invention are described herein for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize. These modifications can be made to the invention in light of the above detailed description. Rather, the scope of the invention is to be determined by the following claims, which are to be interpreted in accordance with established doctrines of claim construction.

What is claimed is:

1. An article of manufacture including a non-transitory computer readable storage medium to tangibly store instructions, which when executed by a computer, cause the computer to:

divide an area around a first object displayed on a user interface including a plurality of objects, into quadrants and a plurality of concentric segments within at least one of the quadrants, wherein the quadrants represent directions with respect to the first object, and the quadrants and concentric segments are displayed on the user interface;

in response to an input indicating a first direction, identify a first one of the quadrants corresponding to the first direction;

scan segments of the first quadrant to identify a second object that is closest to the first object in the first quadrant, wherein:

when there are multiple objects in a segment of a first quadrant, concentrically divide the segment of the first quadrant to subsegments and display the subsegments on the user interface; and

sequentially scan the subsegments, starting from a subsegment that is closest to the first object, to identify the second object that is closest to the first object, wherein the second object is within one of the subsegments, wherein sequentially scan the subsegments includes:

when there is a plurality of objects in the subsegment, identify the second object that is closest to a center line dividing the first quadrant; and

when there are multiple objects from the plurality of objects within same distance from the center line in the subsegment, identify the second object that is left most of the multiple objects from the plurality of objects within same distance from the center line; and

select the second object, wherein the second object is within the segment of the first quadrant.

2. The article of manufacture of claim **1**, wherein the segments of the quadrants are concentric and the instructions to scan the segments of the first quadrant comprises instructions to:

scan the segments sequentially from a center segment.

3. The article of manufacture of claim **1**, further comprising instructions which when executed by the computer further causes the computer to:

when there are multiple objects from the plurality of objects within same distance from the center line in the subsegment, identify the second object that is topmost of the multiple objects from the plurality of objects.

4. The article of manufacture of claim **2**, wherein the segments are divided such that the width of the segments is equal to the shortest of the distances between the plurality of the objects.

5. The article of manufacture of claim **1**, wherein the segments of the first quadrant are parallel and the instructions to scan the segments of the first quadrant comprises instructions to:

scan the segments sequentially starting from a center segment, wherein the first object and the second object comprise text.

6. The article of manufacture of claim **5**, wherein the segments are divided such that the width of the segments is equal to line height of the text.

7. The article of manufacture of claim **1**, wherein the first direction includes an up direction, a down direction, a left direction, or a right direction.

8. A computer-implemented method for keyboard-based navigation, the method comprising:

dividing an area around a first object displayed on a user interface including a plurality of objects into quadrants and a plurality of concentric segments within at least one of the quadrants, wherein the quadrant represent directions with respect to the first object, and the quadrant and concentric segments are displayed on the user interface;

in response to an input indicating a first direction, identifying a first one of the quadrants corresponding to the first direction;

scanning segments of the first quadrant to identify a second object that is closest to the first object in the first quadrant, wherein:

when there are multiple objects in a segment of the first quadrant, concentrically dividing the segment of the first quadrant to subsegments and display the subsegments on the user interface; and

sequentially scanning the subsegments, starting from a subsegment that is closest to the first object, to identify the second object that is closest to the first object, wherein the second object is within one of the subsegments, wherein sequentially scan the subsegments includes:

when there is a plurality of objects in the subsegment, identify the second object that is closest to a center line dividing the first quadrant; and

when there are multiple objects from the plurality of objects within same distance from the center line in the subsegment, identify the second object that is left most of the multiple objects from the plurality of objects within same distance from the center line; and

selecting the second object, wherein the second object is within the segment of the first quadrant.

9. The method of claim **8**, wherein the segments of the quadrants are concentric and scanning the segments of the first quadrant comprises:

scanning the segments sequentially starting from a center segment.

10. The method of claim **8**, further comprising:

when there are multiple objects from the plurality of objects within same distance from the center line in the subsegment, identifying the second object that is topmost of the multiple objects from the plurality of objects.

11. The method of claim **8**, wherein the segments of the quadrants are concentric and dividing the area around the first object into the quadrants comprises:

dividing the area around the first object into four quadrants.

12. The method of claim **11**, wherein the segments are divided such that the width of the segments is equal to the shortest of the distances between the plurality of the objects.

13. The method of claim **8**, wherein the segments of the first quadrant are parallel and scanning the segments of the first quadrant comprises:

scanning the segments sequentially starting from a center segment, wherein the first object and second object comprise text.

14. The method of claim **8**, wherein the segments are divided such that the width of the segments is equal to line height of the text.

15. The method of claim **8**, wherein the first direction includes an up direction, a down direction, a left direction, or a right direction.

16. A computer system for keyboard-based navigation, comprising:

a computer memory to store program code; and

a processor to execute the program code to:

divide an area around a first object displayed on a user interface including a plurality of objects into quadrants and a plurality of concentric segments within at least one of the quadrants, wherein the quadrants represents directions with respect to the first object, and the quadrants and concentric segments are displayed on the user interface;

in response to an input indicating a first quadrant to identify a second object that is closest to the first object in the first quadrant;

scan segments of the first quadrant to identity a second object that is closest to the first object in the first quadrant, wherein:

when there are multiple objects in a segment of the first quadrant, concentrically divide the segment of the first quadrant to subsegments and display the subsegments on the user interface; and

sequentially scan the subsegments, starting from a subsegment that is closest to the first object, to identify the second object that is closest to the first object, wherein the second object is within one of the subsegments, wherein sequentially scan the subsegments includes:

when there is a plurality of objects in the subsegment, identify the second object that is closest to a center line dividing the first quadrant; and

when there are multiple objects from the plurality of objects within same distance from the center line in the subsegment, identify the second object that is left most of the multiple objects from the plurality of objects within same distance from the center line; and

select the second object, wherein the second object is within the segment of the first quadrant.

17. The system of claim **16**, wherein the segments of the quadrant are concentric and the program code to scan the segments of the first quadrant comprises program code to:

scan the segments sequentially starting from a center segment.

18. The system of claim **16**, wherein the segments of the quadrant are concentric and the program code to divide the area around the first object into the quadrant comprises program code to:

divide the area around the first object into four quadrants.

19. The system of claim **18**, wherein the segments are divided such that the width of the segments is equal to the shortest of the distances between the plurality of the objects.

20. The system of claim **16**, wherein the segments of the first quadrant are parallel and the program code to scan the segments of the first quadrant comprises program code to:

scan the segment sequentially starting from a center segment, wherein the first object and second object comprise text.

21. The system of claim **16**, wherein the segments are divided such that the width of the segments is equal to line height of the text.

22. The system of claim **16**, wherein the first direction includes an up direction, a down direction, a left direction, or a right direction.

* * * * *